**M1.**

Full evaluation referencing that the steps are right but the order is wrong, giving the correct order

*oe*

*B1 for a partial explanation eg references incorrect order without being specific*

**B2**

**[2]**

**M2.**

$\frac{1}{125^{\frac{2}{3}}}$ or $5^{-2}$ or $(\sqrt[3]{125})^{-2}$

or $\sqrt[3]{125} = 5$

**M1**

$\frac{1}{(\sqrt[3]{125})^2}$ or $\frac{1}{(\sqrt[3]{125})^2}$ or $\left(\frac{1}{(\sqrt[3]{125})^2}\right)^2$

or $\sqrt[3]{\left(\frac{1}{125}\right)^2}$ or $125^{\frac{2}{3}} = 25$

or $\frac{1}{5^2}$ or $\left(\frac{1}{5}\right)^2$ or $25^{-1}$ or $0.2^2$

**M1dep**

$\frac{1}{25}$

*oe* *0.04*

**A1**

**[3]**

**M3.** $101.4^{\frac{1}{2}}$ estimated as 10

*condone − 10*

**B1**

$(6.43^0 =)$ 1

**B1**

$7.99^{\frac{2}{3}}$ estimated as 4

**B1**

14

*condone −6 if −10 used*
*ft fully correct evaluation with B2 scored*

**B1ft**

**[4]**

**M4.**

(a) $x^7$

B1 $\sqrt{x^{14}}$ or $(x^{14})^{\frac{1}{2}}$ or $\sqrt{x^{5+9}}$

or $(x^{5+9})^{\frac{1}{2}}$ or $x^{\frac{14}{2}}$ or $x^{\frac{5+9}{2}}$

or $x^{\frac{5}{2}} \times x^{\frac{9}{2}}$ or $x^{2.5} \times x^{4.5}$

**B2**

(b) 0.2 or $\frac{1}{5}$ or $5^{-1}$

*B*1 $125^{-\frac{1}{3}}$ or $-\sqrt[3]{125}$

or $\left(\frac{1}{125}\right)^{\frac{1}{3}}$ or $\sqrt[3]{\frac{1}{125}}$

or $\frac{1}{125^{\frac{1}{3}}}$ or $\frac{1}{\sqrt[3]{125}}$

or $\left(\frac{1}{5^3}\right)^{\frac{1}{3}}$ or $\sqrt[3]{\frac{1}{5^3}}$

or $\frac{1^{\frac{1}{3}}}{5}$ or $\frac{\sqrt[3]{1}}{5}$

or $\frac{1}{y^3} = 125$ or $y^3 = \frac{1}{125}$ or $\frac{1}{y} = 5$

or $\frac{1}{y} = \sqrt[3]{125}$ or $\frac{1}{y} = 125^{\frac{1}{3}}$

**B2**

**[4]**

**M5.** $\frac{1}{8^{\frac{2}{3}}}$ or $\frac{1}{\sqrt[3]{8^2}}$ or $\frac{1}{\left(\sqrt[3]{8}\right)^2}$ or $\sqrt[3]{8} = 2$

or $\frac{1}{2^2}$ or $2^{-2}$ or $4^{-1}$ or $2^2 = 4$

**M1**

$\frac{1}{4}$ or 0.25

**A1**

**[2]**

**M6.** $m = 5$

**B1**

$(3^2)^p = 3^m$ or $3^{2p} = 3^m$

or $(3^2)^p = 3^{\text{their } 5}$ or $3^{2p} = 3^{\text{their } 5}$

or $3^5 = 243$ or $3^{\text{their } 5} = \left(\sqrt{9}\right)^{\text{their } 5}$

or $3^{\text{their } 5}$ correctly evaluated

$9^p = 9^{\frac{m}{2}}$ or $9^p = 3^{\text{their } 5}$

or $9^p = 243$ or $3^{2p} = 243$

*oe*

**M1**

$2p = m$ or $2p =$ their 5 or $9^p = 9^{\frac{\text{their 5}}{2}}$

*oe*

**M1**

$p = 2.5$

*oe*

*ft for values of m and p where* $p = \frac{m}{2}$

**A1ft**

**[4]**

**M7.**

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

*B2* $(x^{\frac{-1}{3}})^2$ or $(x^2)^{\frac{-1}{3}}$ or $(x^{\frac{2}{3}})^{-1}$ or $(x^{-2})^{\frac{1}{3}}$ or $(x^{\frac{1}{3}})^{-2}$ or $\frac{1}{x^{\frac{2}{3}}}$ or $-\frac{2}{3}$

*B1* $(\sqrt[3]{x})^2$ or $(\sqrt[3]{x^2})^{-1}$ or $(\frac{1}{x^2})^{\frac{1}{3}}$ or $\frac{1}{(x^2)^{\frac{1}{3}}}$ or $(\frac{1}{\sqrt[3]{x}})^2$ *or base x with any negative index.*

**B3**

**[3]**

**M8.** Correct evaluation of a relevant power of 2 or 16

*eg* $16^{\frac{1}{2}} = (\pm)\ 4$ *or* $16^2 = 256$ *or* $2^4 = 16$ *or*

or $4c = d$

$16^{\frac{1}{4}} = (\pm)2$ *or* $16^1 = 16$ *or* $16^0 = 1$

**M1**

One correct pair of answers

*A correct answer is such that d = 4c*

**A1**

A second correct pair of answers

*eg c = 0, d = 0*

*c = 1, d = 4 or c = – 1, d = – 4*

*c = 2, d = 8 or* $c = \frac{1}{8}$ *,* $d = \frac{1}{2}$ *etc …*

**A1**

**[3]**

**M9.** $(\sqrt[3]{64})^2$ or $(\sqrt[3]{64^2})$ or $4^2$ or $\sqrt[3]{4096}$

**M1**

16

**A1**

**[2]**

**M10.** (a) $\frac{1}{27}$

*B2 for 27 or* $\frac{1}{3}$ *or* $\frac{1}{729}$ *or* $27^{-1}$

*B1 for 3 or 729 or* $\frac{1}{9^{\frac{3}{2}}}$ *or −27*

**B3**

(b) $2^{3m}\left(=2^{m^2}\right)$ or $\left(2^3\right)^m\left(=2^{m^2}\right)$

*oe*

**M1**

$m^2 = 3m$ or $m^2 - 3m = 0$ or $m(m - 3) = 0$

or $(m =) 0$ or $(m =) 3$

*oe*

**M1 dep**

0 **and** 3

**A1**

**[6]**

**M11.** $\sqrt[3]{27}(=3)$ or $27^2$ or 729

*Do not allow* $\sqrt[3]{27}=9$

**M1**

9

**A1**

**[2]**

**M12.** (a) Sight of $\sqrt{4}=2$ followed by $2^3$ or $4^3$ followed by $\sqrt{64}$

*B1 for partial solution but incomplete*

*eg for* $\sqrt{4}=2$ *seen or 64 seen*

**B2**

(b) $(4^y =)\ (4^{1.5})^6$ or $(2^2)^y = (2^3)^6$

*Allow* $1.5 \times 6$ *or* $2 \times y = 3 \times 6$

**M1**

9

*Allow* $\frac{18}{2}$ *and* $4^9$

**A1**

**[4]**

**M13.** B1 for $64^{\frac{1}{3}} = 4$

B1 for $4^{\frac{3}{2}} = 8$

B1 for $27^{\frac{2}{3}} = 9$

**B3**

**[3]**

**M14.**

$\frac{4}{3}\pi x^3 (=) \frac{2}{3}\pi y^3$

*oe e.g. 1* $\frac{4}{3}\pi \times x^3 (=) \frac{1}{2} \times \frac{4}{3}\pi \times y^3$

*e.g. 2* $y^3 = 2x^3$

**M1**

$(\frac{y^3}{x^3} =) \frac{\frac{4}{3}\pi}{\frac{2}{3}\pi}$ **or** $y = \sqrt[3]{2}x$

*oe e.g.* $\frac{y^3}{x^3} = 2$

**M1dep**

$2^{\frac{1}{3}}$

$\sqrt[3]{2}$ *scores M2 A0*

**A1**

**[3]**

**M15.** $9^{\frac{1}{2}} = 3$ or $(-7)^\circ = 1$

**B1**

$\left(\frac{1}{8}\right)^{-\frac{1}{3}} = 8^{\frac{1}{3}}$ or $\frac{1}{\sqrt[3]{\frac{1}{8}}}$ or $\frac{1}{\frac{1}{2}}$ or $\sqrt[3]{8}$ *oe*

$-\frac{1}{2}$ *implies M1*

or $\left(\frac{1}{2}\right)^{-1}$ or $\left(\frac{1}{8}\right)^{\frac{1}{3}} = \frac{1}{2}$ or $\sqrt[3]{8} = \frac{1}{2}$ **M1**

$\left(\frac{1}{8}\right)^{-\frac{1}{3}} = 2$ **A1**

All three numbers correctly evaluated and in correct order

$(-7)^{\circ}$

$\left(\frac{1}{8}\right)^{-\frac{1}{3}}$

$9^{\frac{1}{2}}$ **A1**

**[4]**