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

(6.430 =) 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 22 = 4

M1

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

A1

[2]

M6. $m = 5$

B1

(32)p = 3m or 32p = 3m

or (32)p = 3their 5 or 32p = 3their 5

or 35 = 243 or 3their 5 = $\left(\sqrt{9}\right)^{\text{their 5}}$

or 3their 5 correctly evaluated

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

or 9p = 243 or 32p = 243

oe

M1

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

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 $4^c = d$

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

M1

One correct pair of answers

A correct answer is such that $d = 4^c$

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. (3√64)2 or (3√642) or 42 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

$m2 = 3m$ or $m2 − 3m = 0$ 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 272 or 729

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

M1

9

A1

[2]

M12. (a) Sight of $\sqrt{4}=2$ followed by 23 or 43 followed by $\sqrt{64}$

B1 for partial solution but incomplete

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

B2

(b) (4*y* =) (41.5)6 or (22)*y* = (23)6

Allow 1.5 × 6 or 2 × y = 3 × 6

M1

9

Allow $\frac{18}{2}$ *and 49*

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 $y3 = 2x$

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)°

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

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

[4]