Q1.

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 $d = 4c$

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]

Q2.

(a) $\frac{1}{81^{\frac{1}{4}}}$ or $\frac{1}{\sqrt[4]{81}}$ or $\sqrt[4]{\frac{1}{81}}$

or 3^{-1} or $9^{-\frac{1}{2}}$

or $81^{\frac{1}{4}} = 3$ or $\sqrt[4]{81} = 3$

or $3^4 = 81$

M1

$\frac{1}{3}$

A1

Additional Guidance

3 without $81^{\frac{1}{4}}$ or $\sqrt[4]{81}$

M0A0

(b) **Alternative method 1**

$(16 =)\ 2^4$

or $(2^3)^{2x}$ or 2^{6x}

oe with consistent base 2

M1dep

(16 =) 2^4 and $(2^3)^{2x}$ or 2^{6x}

M1dep

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

A1

Alternative method 2

$((4 \times 8^x)^2 =) (2^2 \times 2^{3x})^2$

M1

$(2^{2+3x})^2$

M1dep

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

oe index

A1

[5]

Q3.

16

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

B1 for $\sqrt[3]{64 \times 64}$

B1 for $\left(64^{\frac{1}{3}}\right)^2$ oe

B1 for $\left(64^2\right)^{\frac{1}{3}}$ oe

B2

[2]

Q4.

(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]

Q5.

$\frac{1}{3}$ or 0.33...

B1 3^{-1} *or* $\frac{\sqrt{1}}{3}$ *or* $\left(\frac{1}{9}\right)^{\frac{1}{2}}$ *or* $\sqrt{\frac{1}{9}}$ *or* $\frac{1}{9^{\frac{1}{2}}}$ *or* $\frac{1}{\sqrt{9}}$

B2

Additional Guidance

For B1 responses $\frac{1}{2}$ can be 0.5

For final two B1 responses 1 can be $\sqrt{1}$

[2]

Q6.

(a) m^3

Do not accept $m \times m \times m$

B1

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

or $3 \times 5 + 2\sqrt{2} - \sqrt{2}\sqrt{2}$

or $13 + 5\sqrt{2} - 3\sqrt{2}$

oe 4 terms or correct combination of 3 terms needed. If 4 terms given, 3 must be correct for M1

Allow in 'box method' or FOIL but watch out for correct signs (still allow one error).

M1

$13 + 2\sqrt{2}$

A1

Additional Guidance

If answer correct allow 2 marks.

$15 + 5\sqrt{2} - 3\sqrt{2} + 4$

M1

$19 + 2\sqrt{2}$

A0

×	3	$\sqrt{2}$
5	15	$5\sqrt{2}$
$\sqrt{2}$	$3\sqrt{2}$	2

$17 + 8\sqrt{2}$

M0
(Only two terms correct)

×	3	$\sqrt{2}$
5	15	$5\sqrt{2}$
$-\sqrt{2}$	$3\sqrt{2}$	2

$13 + 2\sqrt{2}$

M1
A1
(Terms incorrect in table but 'recovered')

$5 \times 3 = 15$, $3 \times \sqrt{2} = 3\sqrt{2}$, $5 \times \sqrt{2} = 5\sqrt{2}$, $-\sqrt{2} \times \sqrt{2} = -2$

M1

$13 + 8\sqrt{2}$

A0

(c) $\frac{27}{5}$ or $5\frac{2}{5}$ or 5.4

B2 for 27 and $\frac{1}{5}$

B2 for $\frac{1}{5} \times 3^3$

B1 for 27 or $\frac{1}{5}$

B1 for 5 ***and*** *3 seen*

Additional Guidance

$\frac{1}{5} \times 3^3 = \frac{1}{5} \times 9 = 1.8$

B2

$\frac{1}{5} \times 9 = 1.8$

B1

$\sqrt{25} = \pm 5$ and $\sqrt[4]{81} = \pm 3$ (allow a mixture or + and – for 3 and 5 but negative elsewhere not allowed)

B1

[6]

Q7.

$101.4^{\frac{1}{2}}$ 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]

Q8.

(a) 5

B1

(b) 1

B1

(c) $\sqrt[3]{27}$ or 3

M1

$\frac{1}{7^2}$ or $\left(\frac{1}{7}\right)^2$ or $\frac{1}{49}$

M1

$\frac{3}{49}$

A1

[5]

Q9.

2

B1

$\frac{1}{5^2}$ or $\frac{1}{25}$ or 0.04

$\frac{2}{25}$ *scores B1M1*

M1

0.08

A1

[3]

Q10.

$\frac{1}{3}$

B1

[1]

Q11.

$3x - (x - 5)$

Condone omission of brackets

M1

$2x + 5 = 17$

M1

6

SC2 11

A1

Alternative 1

$2^{3x} = 2^{17} \times 2^{x-5}$

M1

$3x = 12 + x$

M1

6

SC2 11

A1

Alternative 2

Substitutes a value for x and evaluates correctly as a power of 2.

M1

Substitutes a different value for x and evaluates correctly as a power of 2 which is closer to 17.

M1

6

SC2 11

A1

[3]

Q12.

$x^{-\frac{2}{3}}$ 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 $(\sqrt[3]{x}3)^{-2}$ 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]