

## POWERS AND ROOTS

### Pearson Edexcel - Tuesday 19 May 2020 - Paper 1 (Non-Calculator) Higher Tier

1.

11	(a)	300	M1	for working out $\sqrt[3]{81}$ as 3 or $\sqrt[3]{10^6}$ as $10^2$ or 100	Mark may be awarded if operations are attempted on 8100000000 eg 300000000
			A1	for 300 or $3 \times 10^2$ or $3 \times 100$	
	(b)	$\frac{1}{8}$	M1	for showing a square root of 64 as 8 or recognition of the reciprocal eg $\frac{1}{n}$ or shows expressions that show an understanding of the $\frac{1}{2}$ index and the minus index eg $\frac{1}{\sqrt{64}}$ or other equivalent forms	
			A1	oe	
	(c)	$3^{2-n}$	M1	for $3^{2(n-1)}$ or $3^{2n-2}$ or $(3^2)^{n-1}$	
			A1	for $3^{2-n}$ oe eg $3^{n-2(n-1)}$	

### Pearson Edexcel - Tuesday 11 June 2019 - Paper 3 (Calculator) Higher Tier

2.

12	Explanation	C1	for explanation eg needs to find 4th root or gives the correct answer of 2.828... <b>Acceptable examples:</b> He needs to find $\sqrt[4]{64}$ It should be 2.8...(or $2\sqrt{2}$ ) It is not asking for $64 \div 4$ , it is asking what number to the power of 4 = 64 $64^{\frac{1}{4}}$ means the fourth root not a quarter of 64 $64^{\frac{1}{2}}$ means square root and square root again, not divide by 4 <b>Not acceptable examples:</b> It should be 2 The expression is 64 to the power of $\frac{1}{4}$ $64^{\frac{1}{4}}$ is not a $\frac{1}{4}$ of 64
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### Pearson Edexcel - Tuesday 6 November 2018 - Paper 1 (Non-Calculator) Higher Tier

3.

14	(a)	$\frac{8}{27}$	M1	for showing the 4th root of 16 as 2 and the 4th root of 81 as 3 or $\frac{8}{n}$ ( $n \neq 27$ ) or $\frac{n}{27}$ ( $n \neq 8$ ) or an intention to find the 4th root and cube, eg. $\sqrt[4]{\left(\frac{16}{81}\right)^3}$ or $\left(\sqrt[4]{\frac{16}{81}}\right)^3$ oe
			A1	cao
	(b)	0	M1	for writing $\frac{1}{9} = 3^{-2}$ , $9\sqrt{3} = 3^{2.5}$ , $\frac{1}{\sqrt{3}} = 3^{-0.5}$ as powers of 3, with at least 2 correct or for working out $\frac{1}{9} \times 9\sqrt{3} \times \frac{1}{\sqrt{3}} = 1$
			A1	cao

**Pearson Edexcel - Thursday 24 May 2018 - Paper 1 (Non-Calculator) Higher Tier**

4.

9	(a)	6	B1	cao	Accept $\pm 6$
	(b)	1	B1	cao	
	(c)	$\frac{1}{9}$	M1	for evidence of working with a cube root eg $\sqrt[3]{27}$ or $\sqrt[3]{729}$  OR evidence of working with a reciprocal eg $\frac{1}{27^{2/3}}$ or $\left(\frac{1}{27}\right)^{\frac{2}{3}}$	
			A1	cao	

**Pearson Edexcel - Thursday 24 May 2018 - Paper 1 (Non-Calculator) Higher Tier**

5.

13		5	M1	for $\sqrt{40}$ or $\sqrt{90}$  OR $2\sqrt{2}$ or $3\sqrt{2}$	Answer of $5\sqrt{10}$ from correct working gets M2 A0
			M1	for $2\sqrt{10}$ or $3\sqrt{10}$ or $\sqrt{4} \times \sqrt{10}$ or $\sqrt{9} \times \sqrt{10}$ or $\sqrt{4 \times 10}$ or $\sqrt{9 \times 10}$  OR $2\sqrt{2} + 3\sqrt{2}$	
			A1	cao	

**Pearson Edexcel - Thursday 2 November 2017 - Paper 1 (Non-Calculator) Higher Tier**

6.

10	(a)		10	B1	accept $\pm 10$
	(b)		25	M1	for $(\sqrt[3]{125})^2$ or $\sqrt[3]{125} = 5$ or $125^2 = 15625$ or $\sqrt[3]{125^2}$
				A1	cao

**Pearson Edexcel - Thursday 25 May 2017 - Paper 1 (Non-Calculator) Higher Tier**

7.

12	(a)		$\frac{1}{9}$	M1	for showing a method using either reciprocal or square root e.g. $\frac{1}{n}$ or 9 seen
			A1	cao Accept $\pm \frac{1}{9}$ or 0.1 recurring	
	(b)		$\frac{16}{25}$	M1	for showing cube root of 64 as 4 and the cube root of 125 as 5 or $\frac{16}{n}$ ( $n \neq 25$ ) or $\frac{n}{25}$ ( $n \neq 16$ ) or an intention to find the cube root and square.
				A1	cao Accept 0.64

**Pearson Edexcel - Specimen Papers Set 2 - Paper 2 (Calculator) Higher Tier**

8.

14		explanation	C1	for a correct evaluation, eg the value of $D$ should be multiplied by 8, she has used $2 \times 3$ instead of $2^3$
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**Pearson Edexcel - Specimen Papers Set 2 - Paper 2 (Calculator) Higher Tier**

9.

16	(i)		200	B1	cao
	(ii)		5.6	B1	For 5.6(2...)

**Pearson Edexcel - Specimen Papers Set 1 - Paper 1 (Non-Calculator) Higher Tier**

10.

11		25	B1	cao
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**Pearson Edexcel - Wednesday 9 November 2011 - Paper 3 (Non-Calculator) Higher Tier**

11.

18	(a)		1	1	B1	cao
	(b)		-2	1	B1	cao
	(c)	$9^{-3/2} = 1/9^{3/2} = 1/3^3$	$\frac{1}{27}$	2	M1	use of reciprocal eg $1/9^{3/2}$ or square root eg $3^{-3}, \frac{1}{3^3}$ or $\sqrt{729}$ seen or 27 seen or -27 seen A1

**Pearson Edexcel - Monday 7 June 2010 - Paper 3 (Non-Calculator) Higher Tier**

12.

24	(i)		1	1	B1	cao
	(ii)		8	1	B1	for 8 or -8 or $\pm 8$
	(iii)		$\frac{4}{9}$	2	M1	for $\left(\frac{8}{27}\right)^{2/3}$ oe or $\left(\frac{3}{2}\right)^{-2}$ oe or $\left(\frac{2}{3}\right)^2$ oe or $\left(\frac{1}{\sqrt[3]{27/8}}\right)^2$ or better or $\frac{9}{4}$ oe seen A1

**Pearson Edexcel - Thursday 5 November 2009 - Paper 3 (Non-Calculator) Higher Tier**

13.

14	(a)		1	1	B1	cao
	(b)		$\frac{1}{2}$	1	B1	oe Accept 0.5

OCR GSCE – Thursday 5 November 2020 – Paper 5 (Non-Calculator) Higher Tier

14.

11	(a)	$\frac{1}{4}$ or 0.25	2	B1 for 4 in answer or answer $\frac{1}{n}$ ( $n$ is an integer $> 1$ ) or answer $-4$	For B1 accept decimal equiv provided $\frac{1}{n}$ seen first
11	(b)	$3\sqrt{2}$ final answer	2	B1 for $\sqrt{18}$ or $[\sqrt{6} = \sqrt{3} \times \sqrt{2}]$	Accept eg $3 \times \sqrt{2}$ as final answer for 2 marks

OCR GSCE – Tuesday 6 November 2017 – Paper 5 (Non - Calculator) Higher Tier

15.

16	(a)	$7\sqrt{3}$	3	M2 for $2\sqrt{3}$ and $5\sqrt{3}$ or M1 for $\sqrt{4 \times 3}$ or better or $\sqrt{25 \times 3}$ or better	
	(b)	$\frac{1}{8}$ oe final answer	3	M1 for fourth root <b>soi</b> M1 for cube <b>soi</b> M1 for reciprocal <b>soi</b>	Each step must be correctly evaluated but FT previous step Allow method marks in any order  2 implies M1, $\frac{1}{2}$ implies M1M0M1 8 implies M1M1M0, 4096 implies M0M1M0

OCR GSCE – Thursday 25 May 2017 – Paper 4 (Calculator) Higher Tier

16.

1	(a)	3	2	B1 for 36 or 9	ignore $\pm$
	(b)	$4 \times 10^{-5}$ or [0].000 04	2	B1 for $2.5 \times 10^4$ or 25 000	Condone $\frac{1}{25\ 000}$ for 2 marks

OCR GSCE – Tuesday 13 June 2017 – Paper 6 (Calculator) Higher Tier

17.

17		$\frac{\sqrt[3]{81}}{3} = \frac{\sqrt[3]{3^4}}{3}$ or $\frac{\sqrt[3]{81}}{3} = \frac{\sqrt[3]{3^4}}{3}$ $= \frac{3^{\frac{4}{3}}}{3}$ or $\frac{\sqrt[3]{3^3 \times 3}}{3} = \frac{3 \sqrt[3]{3}}{3}$ $\left[ = 3^{\frac{4}{3}-1} \right] = 3^{\frac{1}{3}}$ or $\sqrt[3]{3} = 3^{\frac{1}{3}}$	<b>M1</b>  <b>M1dep</b>  <b>A1</b> 3 A02.2	$\frac{\sqrt[3]{81}}{3} = \frac{\sqrt[3]{81}}{\sqrt[3]{3^3}}$ $= \sqrt[3]{\frac{81}{27}}$ $= \sqrt[3]{3} = 3^{\frac{1}{3}}$	In left-hand methods, <b>M1M1</b> can be awarded if the denominator 3 is consistently omitted  There may be other surd methods. <b>M1</b> first productive step <b>M1dep</b> second productive step from a correct first step $\sqrt[3]{81} = 81^{\frac{1}{3}}$ is not sufficiently productive as a first step Conversion to decimals scores <b>0</b>
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OCR GSCE – Sample Papers – Paper 6 (Calculator) Higher Tier

18.

7		$(64^{\frac{1}{3}})^2$ $= 4^2 = 16$	<b>2</b> 2 A02.2	<b>B1</b> for $(64^{\frac{1}{3}})^2$ , $4^2$ or $\sqrt[3]{4096}$ oe	Condone $(64^2)^{\frac{1}{3}}$ and $(4096)^{\frac{1}{3}}$ for <b>B1</b>
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AQA GCSE – Tuesday 19 May 2020 – Paper 1 (Non - Calculator) Higher Tier

19.

Q	Answer	Mark	Comments
3	1 000 000	B1	

AQA GCSE – Tuesday 19 May 2020 – Paper 1 (Non - Calculator) Higher Tier

20.

Q	Answer	Mark	Comments
26(a)	$\frac{14}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} \text{ or } \frac{14\sqrt{7}}{7}$	M1	
	$2\sqrt{7}$	A1	do not award if further work eg $\sqrt{14}$
	<b>Additional Guidance</b>		
	Correct answer with no working		M1A1

<b>26(b)</b>	240	<b>B3</b>	<p>B2 any correct single value of the form <math>a\sqrt{b}</math> where <math>a \geq 2</math></p> <p>eg <math>24\sqrt{100}</math> or <math>12\sqrt{400}</math> or <math>8\sqrt{900}</math></p> <p>or <math>6\sqrt{1600}</math> or <math>2\sqrt{14400}</math></p> <p>or</p> <p>correct product of two or more integers</p> <p>eg <math>24 \times 10</math> or <math>8 \times 30</math> or <math>6 \times 40</math></p> <p>or <math>2 \times 2 \times 5 \times 4 \times 3</math></p> <p>B1 (<math>\sqrt{80} = 4\sqrt{5}</math>) or (<math>\sqrt{18} = 3\sqrt{2}</math>)</p> <p>or</p> <p>correct product of two surds</p> <p>eg <math>2\sqrt{800} \times \sqrt{18}</math></p> <p>or <math>2\sqrt{180} \times \sqrt{80}</math></p> <p>or <math>2\sqrt{10} \times \sqrt{1440}</math></p> <p>or</p> <p><math>\sqrt{40} \times \sqrt{80} \times \sqrt{18}</math></p> <p>or</p> <p><math>2\sqrt{10 \times 80 \times 18}</math> or <math>\sqrt{40 \times 80 \times 18}</math></p> <p>or <math>2\sqrt{2 \times 5 \times 4 \times 4 \times 5 \times 2 \times 3 \times 3}</math></p> <p>or <math>\sqrt{2^8 \times 5^2 \times 3^2}</math></p> <p>or</p> <p><math>\sqrt{57600}</math></p>
	<b>Additional Guidance</b>		
	$4\sqrt{5} \times 3\sqrt{2} \times 2\sqrt{10}$		B1
	$4\sqrt{5} \times 3\sqrt{2} \times \sqrt{40}$		B1

AQA GCSE – Tuesday 21 May 2019 – Paper 1 (Non - Calculator) Higher Tier

21.

<b>2</b>	$2\frac{7}{9}$	<b>B1</b>	
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AQA GCSE – Thursday 6 June 2019 – Paper 2 (Calculator) Higher Tier

22.

<b>22</b>	<b>Alternative method 1</b>		
	$(\sqrt{12} =) 2\sqrt{3}$	M1	
	$5\sqrt{3} - 2\sqrt{3} = 3\sqrt{3}$	A1	implies M1A1
	27 with M1A1 seen	A1	
	<b>Alternative method 2</b>		
	$5\sqrt{3} 5\sqrt{3} - 5\sqrt{3} \sqrt{12} - 5\sqrt{3} \sqrt{12}$ $+ \sqrt{12} \sqrt{12}$ or $25\sqrt{3} \sqrt{3} - 10\sqrt{3} \sqrt{12} + \sqrt{12} \sqrt{12}$ or $(5\sqrt{3} 5\sqrt{3} =) 75$ or $(5\sqrt{3} \sqrt{12} =) 30$ or $(10\sqrt{3} \sqrt{12} =) 60$ or $(\sqrt{12} \sqrt{12} =) 12$	M1	oe expansion eg1 $\sqrt{75} \sqrt{75} - \sqrt{75} \sqrt{12} - \sqrt{75} \sqrt{12}$ $+ \sqrt{12} \sqrt{12}$ eg2 $\sqrt{75} \sqrt{75} - \sqrt{900} - \sqrt{900}$ $+ \sqrt{12} \sqrt{12}$
	$75 - 30 - 30 + 12$ or $75 - 60 + 12$	A1	implies M1A1
	27 with M1A1 seen	A1	
	<b>Additional Guidance</b>		
	27 with no working ( $2\sqrt{3}$ not seen)		M0A0A0
	Alt 1 $5\sqrt{3} - \sqrt{12} = 3\sqrt{3}$ ( $2\sqrt{3}$ not seen)		M0A0A0
	Alt 2 $75 - 30 - 30 - 12$		M1A0A0
Alt 1 $5\sqrt{3} - 2\sqrt{3} = 3\sqrt{3}$ followed by $3\sqrt{3}^2 = 27$ (condone missing brackets)		M1A1A1	
Only converting to decimals		M0A0A0	

AQA GCSE – Tuesday 6 November 2018 – Paper 1 (Non - Calculator) Higher Tier

23.

<b>1</b>	$5^8$	B1	
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**AQA GCSE – Tuesday 6 November 2018 – Paper 1 (Non - Calculator) Higher Tier**

24.

16	27 000	B1	
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**AQA GCSE – Tuesday 6 November 2018 – Paper 1 (Non - Calculator) Higher Tier**

25.

17	$\left(\frac{4}{3}\right)^3$ or $\frac{4^3}{3^3}$ or $\left(\frac{27}{64}\right)^{-1}$ or $\frac{1}{\frac{27}{64}}$ or $\frac{1}{\left(\frac{3}{4}\right)^3}$ or $\frac{1}{0.75^3}$ or $\left(\frac{1}{0.75}\right)^3$	M1	
	$\frac{64}{27}$ or $2\frac{10}{27}$	A1	oe fraction, mixed number or decimal
	<b>Additional Guidance</b>		
	$\frac{64}{27}$ followed by an incorrect attempt to convert to a mixed number		M1A1
	$\frac{27}{64}$		M0A0

**AQA GCSE – Monday 24 May 2018 – Paper 1 (Non - Calculator) Higher Tier**

26.

1	40	B1	
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**AQA GCSE – Thursday 2 November 2017 – Paper 1 (Non - Calculator) Higher Tier**

27.

1	10	B1	
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**AQA GCSE – Thursday 2 November 2017 – Paper 1 (Non - Calculator) Higher Tier**

28.

3	$16a^{10}$	B1	
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AQA GSCE – Wednesday 8 November 2017 – Paper 3 (Calculator) Higher Tier

29.

<b>6</b>	Lists three from 3, 9, 27, 81, 243, 729 or lists three from 1, 4, 9, 16, ..., 225, 256, 289 or correctly evaluating a power of 3 + a square number or correctly evaluating 268 – a power of 3 or correctly evaluating 268 – a square number	M1	eg $27 + 25 = 52$ or $3^3 + 5^2 = 52$  eg $268 - 27 = 241$  eg $268 - 49 = 219$
	$243 + 25$ or $3^5 + 5^2$	A1	oe Addition sign must be seen in working or on answer line
	<b>Additional Guidance</b>		
	$3^5, 5^2$ or $3^5$ and $5^2$ on answer line		M1A0
	$268 - 243 = 25$		M1A0
	$243, 25$ or $243$ and $25$ on answer line		M1A0
Beware of $5^3 + 5^2$			

AQA GSCE – Tuesday 13 June 2017 – Paper 3 (Calculator) Higher Tier

30.

<b>2</b>	1	B1	
	<b>Additional Guidance</b>		

AQA GSCE – Sample Paper 1 (Non - Calculator) Higher Tier

31.

<b>2</b>	$3^8$	B1	
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AQA GSCE – Sample Paper 3 (Calculator) Higher Tier

32.

<b>1</b>	10 000	B1	
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