Write your name, centre number and candidate number in the boxes below.

| Surname | Other names |
|---|---|
| | |

Centre number | | | | | |

Candidate number | | | | |

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# Fractional and negative indices

Time allowed: 45 minutes

**Subject code** **0580**

# Mathematics

## Questions from Paper 2 and Paper 4

**You must have:** a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
**You may use a calculator.**

Total marks

**/ 34**

### Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

### Information

- This paper has 10 questions worth 34 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

### Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

**1** $81^x = 3$

Find the value of $x$.

*Answer* $x =$ ..... [1]

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| | | | |
|---|---|---|---|
| **1** | $\frac{1}{4}$ or 0.25 | **1** | |

**2** $2^p = \frac{1}{8^4}$

Find the value of $p$.

$p =$ ..... [2]

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| | | | |
|---|---|---|---|
| **2** | –12 | **2** | **B1** for $2^3$, $2^{-3}$, $2^{12}$ or $2^{-12}$ |

**3** $\sqrt[3]{y^2} = \sqrt[6]{x}$ and $y = \sqrt[n]{x}$.

Find the value of $n$.

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$n =$ ..... [2]

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| | | | |
|---|---|---|---|
| **3** | 4 | **2** | **M1** for $y^{\frac{2}{3}} = x^{\frac{1}{6}}$ or $y^2 = \sqrt{x}$ or $y^4 = x$ |

**4** $m^{-\frac{1}{4}} = 27m^{-1}$

Find the value of $m$.

$m =$ ..... [3]

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| | | | |
|---|---|---|---|
| **4** | 81 | **3** | **M2** for $m^{\frac{3}{4}} = 27$ or better<br>or **M1** for $\frac{1}{m^{\frac{1}{4}}} = \frac{27}{m}$ or better<br>or $m^{-\frac{1}{4}--1} = 27$<br>If **0** scored **SC1** for answer $\frac{1}{81}$ |

**5** Solve.

$$\left(\frac{1}{3}\right)^{x} = 9^{x+4}$$

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$x =$ ..... [3]

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| | | | |
|---|---|---|---|
| **5** | $-\frac{8}{3}$ or $-2\frac{2}{3}$ oe | **3** | **M2** for $-x = 2(x + 4)$ oe<br>or **M1** for $(3^{-1})^x$, $3^{-x}$, $(3^2)^{x+4}$, $3^{2(x+4)}$ or $\left(\frac{1}{3}\right)^{-2(x+4)}$ oe |

**6** $\dfrac{16^{5m}}{4} = 64^{2n}$

Find $m$ in terms of $n$.

$m =$ ..... [3]

Fractional and negative indices Click for more variations

| | | | |
|---|---|---|---|
| **6** | $[m =] \frac{6n+1}{10}$ oe | **3** | **M2** for $2(5m) - 1 = 3(2n)$ oe or better<br>or **M1** for $42(5m)$ or for $43(2n)$ oe or better |

**7** **(a)** Simplify. $(16x^{16})^{\frac{3}{4}}$

..... [2]

**(b)** $2p^{\frac{3}{2}} = 54$

Find the value of $p$.

$p =$ ..... [2]

(a) Roots and indices in algebra (b) Fractional and negative indices Click for more variations

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| | | | |
|---|---|---|---|
| **7**(a) | $8x^{12}$ final answer | **2** | **B1** for $8x^k$ or $kx^{12}$ in final answer $k \neq 0$ |
| **7**(b) | 9 | **2** | **M1** for $27^{\frac{2}{3}}$ or $3^k$ or $p^{\frac{1}{2}} = 3$ or $p^3 = 729$ |

**8** **(a)** $3^{-2} \times 3^{x} = 81$

Find the value of $x$.

$x =$ ..... [2]

**(b)** $x^{-\frac{1}{3}} = 32x^{-2}$

Find the value of $x$.

$x =$ ..... [3]

(a) Laws of indices (b) Fractional and negative indices Click for more variations

| | | | |
|---|---|---|---|
| **8**(a) | 6 | **2** | **B1** for $3^4$ or $3^{x-2}$<br>or **M1** for $3^x = 81 \times 3^2$ or better |
| **8**(b) | 8 | **3** | **M2** for $x^{\frac{5}{3}} = 32$ or better<br>or **M1** for $\frac{1}{x^{\frac{1}{3}}} = \frac{32}{x^2}$ or better<br>or $x^{-\frac{1}{3}--2} = 32$ or better |

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**9** **(a)** Simplify.

$$\frac{x^{\frac{2}{3}}}{x^{\frac{8}{3}}}$$

..... [1]

**(b)** $16 = 64^k$

Find the value of $k$.

$k =$ ..... [1]

**(c)** Solve.

$$3^{3x} \times \left(\frac{1}{9}\right)^{4-3x} = 3$$

$x =$ ..... [3]

(a) Laws of indices (b) Fractional and negative indices (c) Fractional and negative indices Click for more variations

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| | | | |
|---|---|---|---|
| **9**(a) | $x^{-2}$ or $\frac{1}{x^2}$ final answer | **1** | |
| **9**(b) | $\frac{2}{3}$ | **1** | |
| **9**(c) | 1 nfww | **3** | **M1** for $3^{-2(4-3x)}$ oe or better<br>or $9^{\frac{3x}{2}} \times 9^{-(4-3x)} = 9^{\frac{1}{2}}$ oe or better<br>**M1** for $3x + (their - 2) \times (4 - 3x) = 1$ oe or better<br>or $their\frac{3x}{2} - (4-3x) = their\frac{1}{2}$ oe or better |

**10** **(a)** Simplify $\left(\frac{x^2}{4}\right)^{\frac{3}{2}}$.

..... [2]

**(b)** $16^x \times \left(\frac{1}{2}\right)^x = 4^{x+3}$

Find the value of $x$.

$x =$ ..... [4]

(a) Roots and indices in algebra (b) Fractional and negative indices Click for more variations

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| | | | |
|---|---|---|---|
| **10**(a) | $[\pm]\frac{x^3}{8}$ final answer | **2** | **B1** for $\frac{x^3}{k}$ or $\frac{x^k}{8}$ |
| **10**(b) | 6 nfww | **4** | **B3** for $4x - x = 2(x + 3)$ oe<br><br>or for correctly combining to a single base on each side with no brackets in the powers e.g. $2^{3x} = 2^{2x+6}$ oe or better<br><br>OR<br><br>**M1** for $(2^4)^x$ or $(2^{-1})^x$ or $2^{2(x+3)}$ or better seen<br><br>**M1** for correctly forming a linear equation in $x$ from *their* powers of *their* consistent base |

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