



1 Write down the value of

a. $\sqrt{144}$

b. $\sqrt[3]{125}$

c. $\sqrt{0.49}$

d. $\sqrt[3]{-8}$

(4 marks)

a)

$$12 \times 12 = 144$$

12

b)

$$5 \times 5 \times 5 = 125$$

5

c)

$$0.7 \times 0.7 = 0.49$$

0.7

d) a negative cubed is negative

= -

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2 Here are five numbers.

6 9 16 27 40

Write down the two numbers that are powers of 3

(1 mark)

The powers of 3 are 3, 9, 27, 81, ..

From the list, $9 = 3^2$ and $27 = 3^3$

9 and 27

3

- a. Work out the value of
 (i) 2^6 (ii) 3^4 (iii) 5^3
 b. Write 64 as a power of 4.
 c. Write 243 as a power of 3.

(3 marks)

a.)

$$2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64$$

$$3^4 = 3 \times 3 \times 3 \times 3 = 81$$

$$5^3 = 5 \times 5 \times 5 = 125$$

64, 81, 125

b) powers of 4: 4, 16, 64

4^3

c) powers of 3: 3, 9, 27, 81, 243

3^5

4

- a. Write 10^5 as an ordinary number.
 b. Write one million as a power of 10.
 c. Write 10^{-2} as a decimal.
 d. Write $10^3 \times 10^4$ as a single power of 10.

(4 marks)

a) 5 zeros

100 000

b) 1 000 000 has 6 zeros

10^6

c.)

$$10^{-2} = \frac{1}{100}$$

0.01

d) multiply: add the powers

$$10^3 \times 10^4 = 10^{3+4}$$

10^7

5 Write down the value of 100^3

(1 mark)

100^3 means $100 \times 100 \times 100$

$$100 \times 100 = 10,000 \text{ and } 10,000 \times 100 = 1,000,000$$

1000000

6 Work out

a. $2^3 \times 3^2$

b. $5^2 + 4^3$

c. $(10^2 - 6^2) \div 2^3$

(3 marks)

work out the powers first

a)

$$2^3 \times 3^2 = 8 \times 9$$

$$8 \times 9 = 72$$

72

b)

$$5^2 + 4^3 = 25 + 64$$

$$25 + 64 = 89$$

89

c) bracket first

$$10^2 - 6^2 = 100 - 36 = 64$$

$$2^3 = 8$$

$$64 \div 8 = 8$$

8

7 a. Write 507,000 in standard form.

b. Write 2.6×10^{-3} as an ordinary number.

(2 marks)

a) $507,000 = 5.07 \times 100,000 = 5.07 \times 10^5$

b) $2.6 \times 10^{-3} = 2.6 / 1000 = 0.0026$

8

Ellie types $\sqrt{50}$ into her calculator. The calculator shows $5\sqrt{2}$

- Explain what $5\sqrt{2}$ means.
- Write $\sqrt{50}$ as a decimal. Give your answer correct to 2 decimal places.
- Ellie types $\sqrt{12}$ and the calculator shows $2\sqrt{3}$. Write $\sqrt{12}$ as a decimal correct to 3 significant figures.

(3 marks)

a) a number next to a root means multiply

$$5 \times \sqrt{2}$$

b) press $5 \Rightarrow 0$ to get a decimal

$$\sqrt{50} = 7.0710...$$

$$7.07$$

c)

$$\sqrt{12} = 3.4641...$$

$$3.46$$

9

- Write $(5^3)^4$ as a single power of 5
- Write down the value of 8^0

(2 marks)

a) For a power of a power, multiply the indices

$$3 \times 4 = 12, \text{ so the answer is } 5^{12}$$

b) Any non-zero number to the power 0 is 1

For the zero power, $8^3 \div 8^3 = 1$, and the division rule writes the same calculation as $8^{(3-3)} = 8^0$

10

- a. Write 8^2 as a power of 2.
 b. Write $4^3 \times 2^5$ as a single power of 2.
 c. Write $9^4 \div 27$ as a single power of 3.

(4 marks)

$$a) 8 = 2^3$$

$$8^2 = (2^3)^2$$

$$(2^3)^2 = 2^6$$

$$\boxed{2^6}$$

$$b) 4 = 2^2$$

$$4^3 = (2^2)^3 = 2^6$$

$$2^6 \times 2^5 = 2^{11}$$

$$\boxed{2^{11}}$$

$$c) 9 = 3^2 \text{ and } 27 = 3^3$$

$$9^4 = (3^2)^4 = 3^8$$

$$3^8 \div 3^3 = 3^5$$

$$\boxed{3^5}$$

11

- Work out $(9 \times 10^8) \div (3 \times 10^{-2})$
 Give your answer in standard form.

(2 marks)

Divide the number parts

$$9 / 3 = 3$$

Subtract the powers

$$10^8 / 10^{-2} = 10^{(8 - (-2))} = 10^{10}$$

So the answer is 3×10^{10}

$$\boxed{3 \times 10^{10}}$$

12

The mass of the Earth is 5.97×10^{24} kg.

The mass of the Moon is 7.35×10^{22} kg.

- Work out how many times heavier the Earth is than the Moon. Give your answer to the nearest whole number.
- Work out the total mass of the Earth and the Moon. Give your answer in standard form, correct to 3 significant figures.

(4 marks)

a) divide

$$(5.97 \times 10^{24}) \div (7.35 \times 10^{22}) = 81.22...$$

81 times

b) make the powers the same

$$7.35 \times 10^{22} = 0.0735 \times 10^{24}$$

$$5.97 + 0.0735 = 6.0435$$

$$\text{total} = 6.0435 \times 10^{24}$$

$$6.04 \times 10^{24} \text{ kg}$$

EXTENSION QUESTIONS

13

a. Here are five numbers.

$$\sqrt{9} \quad \sqrt{10} \quad \sqrt{16} \quad \sqrt{20} \quad \sqrt[3]{8}$$

Which of them are surds?

b. Hamza types $\sqrt{48}$ into his calculator. The display shows $4\sqrt{3}$. Show that $\sqrt{48} = 4\sqrt{3}$ c. Simplify $\sqrt{75}$ d. Work out $\sqrt{2} \times \sqrt{8}$

(4 marks)

a) which roots are not whole numbers?

$$\sqrt{9} = 3, \sqrt{16} = 4, \sqrt[3]{8} = 2$$

$$\boxed{\sqrt{10} \text{ and } \sqrt{20}}$$

b) biggest square factor of 48 is 16

$$\sqrt{48} = \sqrt{16 \times 3}$$

$$\sqrt{48} = \sqrt{16} \times \sqrt{3}$$

$$\sqrt{48} = 4\sqrt{3}$$

$$\boxed{\sqrt{48} = 4\sqrt{3}}$$

c) $75 = 25 \times 3$

$$\sqrt{75} = \sqrt{25 \times 3}$$

$$\sqrt{75} = 5\sqrt{3}$$

$$\boxed{5\sqrt{3}}$$

d)

$$\sqrt{2} \times \sqrt{8} = \sqrt{16}$$

$$\sqrt{2} \times \sqrt{8} = 4$$

$$\boxed{4}$$

14

Work out the value of

a. $49^{1/2}$

b. $64^{1/3}$

c. $16^{3/4}$

d. $27^{-2/3}$

(4 marks)

a) power $\frac{1}{2}$ = square root

$$49^{\frac{1}{2}} = \sqrt{49} = 7$$

$$\boxed{7}$$

b) power $\frac{1}{3}$ = cube root

$$64^{\frac{1}{3}} = \sqrt[3]{64} = 4$$

$$\boxed{4}$$

c) bottom = root, top = power

$$16^{\frac{3}{4}} = (\text{fourth root of } 16)^3$$

$$16^{\frac{3}{4}} = 2^3$$

$$16^{\frac{3}{4}} = 8$$

$$\boxed{8}$$

d) minus = one over

$$27^{\frac{2}{3}} = (\sqrt[3]{27})^2 = 3^2 = 9$$

$$27^{-\frac{2}{3}} = \frac{1}{9}$$

$$\boxed{\frac{1}{9}}$$

15

Rationalise the denominator of $\frac{12}{\sqrt{3}}$

Give your answer in its simplest form.

(2 marks)

Rationalise means remove the square root from the denominator. Multiplying top and bottom by $\sqrt{3}$ multiplies the fraction by $\sqrt{3}/\sqrt{3} = 1$, so it keeps the same value; $\sqrt{3} \times \sqrt{3} = 3$

Multiply the numerator and denominator by $\sqrt{3}$

$$\frac{12}{\sqrt{3}} = \frac{12\sqrt{3}}{3}$$

Divide top and bottom by 3

$$\frac{12\sqrt{3}}{3} = 4\sqrt{3}$$

$$\boxed{4\sqrt{3}}$$

EXTENSION QUESTIONS

16

Rationalise the denominator of each of these. Give each answer in its simplest form.

a. $\frac{10}{\sqrt{5}}$

b. $\frac{3}{2\sqrt{6}}$

c. $\frac{\sqrt{3} + 1}{\sqrt{3}}$

(5 marks)

a) $\times \sqrt{5}$ on top and bottom

$$\frac{10}{\sqrt{5}} = \frac{10\sqrt{5}}{5}$$

$$\frac{10}{\sqrt{5}} = 2\sqrt{5}$$

$$\boxed{2\sqrt{5}}$$

b) $\times \sqrt{6}$ on top and bottom

$$\frac{3}{2\sqrt{6}} = \frac{3\sqrt{6}}{2 \times 6}$$

$$\frac{3}{2\sqrt{6}} = \frac{3\sqrt{6}}{12}$$

$$\frac{3}{2\sqrt{6}} = \frac{\sqrt{6}}{4}$$

$$\boxed{\frac{\sqrt{6}}{4}}$$

c) $\times \sqrt{3}$ on top and bottom

$$\text{top: } (\sqrt{3} + 1) \times \sqrt{3} = 3 + \sqrt{3}$$

$$\text{bottom: } \sqrt{3} \times \sqrt{3} = 3$$

$$\boxed{\frac{3 + \sqrt{3}}{3}}$$