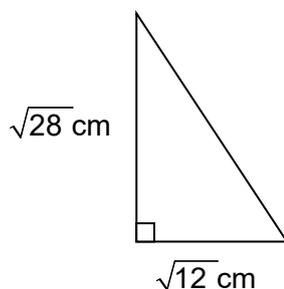


OCR 03 Indices and surds (Higher)

1. Work out 5^{-2} .
2. Write $\frac{1}{4}$ in the form 2^a , where a is an integer.
3. Simplify $(2 \times 10^3) + (5 \times 10^3)$. Write your answer in standard form.
4. Calculate $8^{\frac{1}{3}}$.
5. Simplify $\sqrt{20}$.
6. The area A of a circle with radius r is given by the formula $A = \pi r^2$.
Calculate the area of a circle with radius $2\sqrt{7}$ cm, giving your answer in terms of π .
7. Work out $\left(\frac{8}{27}\right)^{-\frac{2}{3}}$.
8. Calculate the **exact** area of this triangle.



9. Simplify $\frac{(x\sqrt{x})^3}{x^4}$.
10. Find \sqrt{x} when $x = 9 \times 10^{-2}$. Give your answer in standard form.
11. Neil writes $\frac{4^4}{4^{-2}} = 4^6$. Is Neil correct? Explain your answer.
12. Show that $(\sqrt{64})^{\frac{5}{3}} = 32$.

13. Which of the following numbers is the largest? Show how you decide.

$$1^{-2} \quad 2^0 \quad 4^{\frac{1}{2}} \quad (0.5)^{-1}$$

14. Venus is 1.1×10^8 km from the Sun. Neptune is 4.5×10^9 km from the Sun. Zoe wants to know how much further Neptune is from the Sun than Venus is from the sun. Her calculation is shown below.

$$\begin{aligned} (4.5 \times 10^9) - (1.1 \times 10^8) &= (4.5 - 1.1) \times (10^9 - 10^8) \\ &= 3.4 \times 10^1 \text{ km} \end{aligned}$$

Her calculation is incorrect. Show how Zoe should have done the calculation.

15. Show that $\frac{1}{1+\sqrt{2}} = \sqrt{2} - 1$.

16. Ceredig thinks of a number. He raises it to the power 0.25 and gets the answer 3. What number did Ceredig first think of?

17. The number 10^{100} is called one googol. How many googols is the number 3×10^{102} ?

18. Dave's garden is square. It has an area of 130 m^2 . Without using a calculator, estimate the length of Dave's garden to the nearest metre.

19. When a car skids to a stop, the speed s in miles per hour that the car was travelling when it started to skid can be calculated by using the formula $s = \sqrt{30fd}$, where f is the coefficient of friction and d is the length of the skid marks in feet. A car skids to a stop on a road with a speed limit of 40 miles per hour. The skid marks measure 42 feet, and the coefficient of friction was 0.7. Work out the exact speed the car was travelling when it started to skid and say whether it was speeding.

20. The area A of a regular hexagon of side length S is given by the formula $A = \frac{1}{2} \times 3^{\frac{3}{2}} \times S^2$.

Calculate the area of a regular hexagon with side length $3^{\frac{5}{2}}$ cm.

Give your answer in the form $A = k \times 3^c$ where k and c are rational numbers.

Answers

1. $\frac{1}{25}$ or 0.04

2. 2^{-2}

3. 7×10^3

4. 2

5. $2\sqrt{5}$

6. $A = \pi \times (2\sqrt{7})^2$
 $= 28\pi$

7. $\left(\frac{8}{27}\right)^{-\frac{2}{3}} = \left(\frac{2}{3}\right)^{-2}$
 $= \left(\frac{4}{9}\right)^{-1}$
 $= \frac{9}{4}$

8. $\text{Area} = \frac{\sqrt{28} \times \sqrt{12}}{2} = \frac{2\sqrt{7} \times 2\sqrt{3}}{2}$
 $= 2 \times \sqrt{7} \times \sqrt{3} \text{ cm}^2$ or $2\sqrt{21} \text{ cm}^2$ (answer must not be a decimal approximation).

9. $\frac{(x\sqrt{x})^3}{x^4} = \frac{\left(x^{\frac{3}{2}}\right)^3}{x^4}$
 $= \frac{x^{\frac{9}{2}}}{x^4}$
 $= x^{\frac{1}{2}}$ or \sqrt{x}

10. $\sqrt{9 \times 10^{-2}} = \sqrt{\frac{9}{10^2}}$
 $= \frac{3}{10} = 3 \times 10^{-1}$

11. Yes, with explanation. To divide we subtract indices ($4 - -2 = 6$), so answer is 4^6 .

$$12. \sqrt{64} = 8, 8^{\frac{1}{3}} = 2, 2^5 = 32$$

$$13. 1^{-2} = 1, 2^0 = 1, 4^{-\frac{1}{2}} = 0.5, (0.5)^{-1} = 2$$

so $(0.5)^{-1}$ is the largest.

$$14. 4.5 \times 10^9 - 1.1 \times 10^8 = 45 \times 10^8 - 1.1 \times 10^8$$

$$= 43.9 \times 10^8 \text{ km or } 4.39 \times 10^9 \text{ km in standard form.}$$

$$\text{Alternatively, } 4.5 \times 10^9 - 1.1 \times 10^8 = 4.5 \times 10^9 - 0.11 \times 10^9$$

$$= 4.39 \times 10^9 \text{ km}$$

$$15. \frac{1}{1+\sqrt{2}} = \frac{(1-\sqrt{2})}{(1+\sqrt{2})(1-\sqrt{2})}$$

$$= \frac{(1-\sqrt{2})}{1-2}$$

$$= \sqrt{2} - 1$$

$$16. 0.25 = \frac{1}{4} \text{ so } x^{\frac{1}{4}} = 3$$

$$\Rightarrow x = 3^4 = 81$$

$$17. 3 \times 10^{102} = 300 \times 10^{100}$$

so 3×10^{102} is 300 googols.

$$18. 11^2 = 121, 12^2 = 144 \text{ so } \sqrt{130} \text{ lies between 11 and 12.}$$

$$11.5^2 = 132.25 \text{ so } \sqrt{130} < 11.5 \text{ and length is 11 m to the nearest metre.}$$

$$19. \sqrt{30 \times 0.7 \times 42} = \sqrt{21 \times 42}$$

$$= 21\sqrt{2} \text{ mph}$$

$$21\sqrt{2} = 29.7 \text{ (to 1 dp) and } 29.7 < 40 \text{ so car is not speeding.}$$

$$20. A = \frac{1}{2} \times 3^{\frac{3}{2}} \times 3^{\frac{5}{2}} \times 3^{\frac{5}{2}}$$

$$= \frac{1}{2} \times 3^{\frac{13}{2}} \text{ cm}^2$$

(where $k = \frac{1}{2}$ and $c = \frac{13}{2}$)

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Assessment Objective	Qu.	Topic	R	A	G
AO1	1	Calculate with integer powers			
AO1	2	Calculate integer powers			
AO1	3	Add numbers in standard form			
AO1	4	Calculate with fractional powers			
AO1	5	Simplify expressions with surds, including rationalising denominators			
AO1	6	Use surds in exact calculations			
AO1	7	Calculate with fractional powers and roots			
AO1	8	Use surds in exact calculations			
AO1	9	Calculate with fractional powers and roots			
AO1	10	Calculate with integer powers			
AO2	11	Know and apply laws of indices			
AO2	12	Calculate with fractional powers and roots			
AO2	13	Calculate with integer and fractional powers			
AO2	14	Calculate with numbers in standard form			
AO2	15	Simplify expressions with surds, including rationalising denominators			
AO3	16	Calculate fractional powers			
AO3	17	Calculate using standard form			
AO3	18	Estimate powers and roots to the nearest whole number without using a calculator			
AO3	19	Solve a problem by manipulating surds			
AO3	20	Know and apply laws of indices			

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