

Rationalization (Surds)

MCQ Test, Set 07

Time: 30 minutes

Maximum marks: 25

Name: _____ Class: _____ Date: _____

- There are 25 questions. Each has exactly one correct answer: choose A, B, C or D.
- Each correct answer carries 1 mark. There is no negative marking.
- The key sheet and worked solutions are at the end of this test.

1. Which of the following is not a rational number?

A. $\sqrt[6]{64}$

B. $\sqrt[5]{243}$

C. $\sqrt[5]{1024}$

D. $\sqrt[5]{10}$

2. Which of the following statements is true?

A. $\sqrt{10}$ is a rational number.

B. Every irrational number is a surd.

C. π is a surd.

D. Every surd is an irrational number.

3. $4\sqrt{n}$ is a mixed surd when n is

A. 64

B. 27

C. 361

D. 256

4. The conjugate of $9 + \sqrt{14}$ is

A. $-9 + \sqrt{14}$

B. $-9 - \sqrt{14}$

C. $\frac{1}{9+\sqrt{14}}$

D. $9 - \sqrt{14}$

5. $(\sqrt{27})^2 =$

A. $2\sqrt{27}$

B. 27

C. $\sqrt{27}$

D. 729

6. $\frac{\sqrt{19}}{\sqrt{11}} =$

A. $\sqrt{8}$

B. $\frac{19}{11}$

C. $\sqrt{\frac{19}{11}}$

D. $\sqrt{\frac{11}{19}}$

7. $125^{\frac{1}{3}} =$

A. 5

B. 15

C. $\frac{125}{3}$

D. 25

8. $\sqrt[3]{7} \times \sqrt[3]{49} =$

A. 343

B. $\sqrt[6]{343}$

C. 7

D. $\sqrt[3]{56}$

9. If $(k\sqrt{14})^2 = 126$ and $k > 0$, then $k =$

A. $3\sqrt{14}$

B. 9

C. 3

D. 6

10. $(7 + \sqrt{2})(2 + \sqrt{2}) =$

A. $16 - 9\sqrt{2}$

B. $12 + 9\sqrt{2}$

C. 16

D. $16 + 9\sqrt{2}$

11. A rationalising factor of $18 + \sqrt{22}$ is
A. $\sqrt{22}$ **B.** $18 - \sqrt{22}$ **C.** $-\sqrt{22} - 18$ **D.** $18 + \sqrt{22}$
-
12. The rationalising factor of $\sqrt[3]{9} - \sqrt[3]{7}$ is
A. $(\sqrt[3]{9})^2 - \sqrt[3]{9} \cdot \sqrt[3]{7} + (\sqrt[3]{7})^2$ **B.** $(\sqrt[3]{9})^2 + (\sqrt[3]{7})^2$
C. $\sqrt[3]{9} + \sqrt[3]{7}$ **D.** $(\sqrt[3]{9})^2 + \sqrt[3]{9} \cdot \sqrt[3]{7} + (\sqrt[3]{7})^2$
-
13. $\sqrt{32} + \sqrt{128} =$
A. $12\sqrt{4}$ **B.** $\sqrt{160}$ **C.** $12\sqrt{2}$ **D.** $32\sqrt{2}$
-
14. $(5\sqrt{5})^3 =$
A. 625 **B.** $625\sqrt{5}$ **C.** $25\sqrt{5}$ **D.** $125\sqrt{5}$
-
15. $(\sqrt{6} - \sqrt{5})^2 =$
A. $11 + 2\sqrt{30}$ **B.** 1 **C.** $11 - 2\sqrt{30}$ **D.** $61 - 2\sqrt{30}$
-
16. $(9 + 5\sqrt{3})(9 - 5\sqrt{3}) =$
A. -144 **B.** 156 **C.** 66 **D.** 6
-
17. $\frac{1}{6-\sqrt{7}} =$
A. $\frac{6+\sqrt{7}}{29}$ **B.** $-6 - \sqrt{7}$ **C.** $\frac{6+\sqrt{7}}{43}$ **D.** $\frac{6-\sqrt{7}}{29}$
-
18. Rationalising the denominator of $\frac{1}{\sqrt{15}+\sqrt{3}}$ gives
A. $\sqrt{15} - \sqrt{3}$ **B.** $\frac{\sqrt{15}+\sqrt{3}}{12}$
C. $\frac{\sqrt{15}-\sqrt{3}}{12}$ **D.** $\frac{\sqrt{15}-\sqrt{3}}{18}$
-
19. If $\frac{6+5\sqrt{2}}{3-\sqrt{2}} = a + b\sqrt{2}$, then $b =$
A. 9 **B.** -3 **C.** 4 **D.** 3
-
20. $\frac{2+\sqrt{14}}{2-\sqrt{14}} + \frac{2-\sqrt{14}}{2+\sqrt{14}} =$
A. $-\frac{18}{5}$ **B.** $-\frac{4\sqrt{14}}{5}$ **C.** $\frac{18}{5}$ **D.** $-\frac{9}{5}$
-
21. $\frac{1}{4+\sqrt{13}} + \frac{1}{4-\sqrt{13}} =$
A. $\frac{8}{3}$ **B.** $\frac{2\sqrt{13}}{3}$ **C.** $\frac{8}{29}$ **D.** 0
-
22. If $x = \sqrt[3]{8 - 3\sqrt{7}}$, then $x^3 + \frac{1}{x^3} =$
A. 0 **B.** 16 **C.** 8 **D.** $6\sqrt{7}$
-
23. If $x = 3 + 2\sqrt{2}$, then $x^2 - 6x =$
A. 1 **B.** -1 **C.** 0 **D.** -5
-
24. $\sqrt{13} - \sqrt{168} =$
A. $\sqrt{7} - \sqrt{6}$ **B.** $\sqrt{7} + \sqrt{6}$ **C.** $\sqrt{6} - \sqrt{7}$ **D.** $\sqrt{42} - 1$
-

25. $\sqrt{14 + \sqrt{171}} =$

A. $\frac{\sqrt{19+3}}{2}$

C. $\frac{\sqrt{19-3}}{\sqrt{2}}$

B. $\frac{\sqrt{19+3}}{\sqrt{2}}$

D. $\sqrt{19} + 3$

Key sheet

1. D	2. D	3. B	4. D	5. B
6. C	7. A	8. C	9. C	10. D
11. B	12. D	13. C	14. B	15. C
16. D	17. A	18. C	19. D	20. A
21. A	22. B	23. B	24. A	25. B

Solutions

1. Which of the following is not a rational number?

$1^5 = 1$ and $2^5 = 32$, so 10 is not a perfect fifth power. So $\sqrt[5]{10}$ is a surd.

The others are rational: $\sqrt[5]{1024} = \sqrt[5]{4 \times 4 \times 4 \times 4 \times 4} = 4$, $\sqrt[5]{243} = \sqrt[5]{3 \times 3 \times 3 \times 3 \times 3} = 3$, $\sqrt[6]{64} = \sqrt[6]{2 \times 2 \times 2 \times 2 \times 2 \times 2} = 2$

Ans: (D) $\sqrt[5]{10}$

2. Which of the following statements is true?

A surd is never rational, so every surd is irrational.

π is irrational but not a surd, so the second statement is false.

Ans: (D) Every surd is an irrational number.

3. $4\sqrt{n}$ is a mixed surd when n is

$5^2 = 25$ and $6^2 = 36$, so 27 is not a perfect square. So $4\sqrt{27}$ is a mixed surd.

For the others $\sqrt{n}$ is a whole number, so the product is rational.

Ans: (B) 27

4. The conjugate of $9 + \sqrt{14}$ is

Only the sign of the surd part changes: the conjugate of $9 + \sqrt{14}$ is $9 - \sqrt{14}$.

Ans: (D) $9 - \sqrt{14}$

5. $(\sqrt{27})^2 =$

$$\sqrt{27} \times \sqrt{27} = \sqrt{27^2} = 27$$

Ans: (B) 27

6. $\frac{\sqrt{19}}{\sqrt{11}} =$

$$\frac{\sqrt{19}}{\sqrt{11}} = \sqrt{\frac{19}{11}} \text{ (divide the numbers under the roots)}$$

Ans: (C) $\sqrt{\frac{19}{11}}$

7. $125^{\frac{1}{3}} =$

$$125^{\frac{1}{3}} = \sqrt[3]{125} = \sqrt[3]{5^3} = 5$$

Ans: (A) 5

8. $\sqrt[3]{7} \times \sqrt[3]{49} =$

$$\begin{aligned}\sqrt[3]{7} \times \sqrt[3]{49} &= \sqrt[3]{7 \times 49} \\ &= \sqrt[3]{343} = \sqrt[3]{7^3} = 7\end{aligned}$$

Ans: (C) 7

9. If $(k\sqrt{14})^2 = 126$ and $k > 0$, then $k =$

$$(k\sqrt{14})^2 = k^2 \times 14 = 14k^2$$

$$14k^2 = 126, \text{ so } k^2 = 9 \text{ and } k = 3$$

Ans: (C) 3

10. $(7 + \sqrt{2})(2 + \sqrt{2}) =$

$$(7 + \sqrt{2})(2 + \sqrt{2}) = 14 + 7\sqrt{2} + 2\sqrt{2} + 2 \\ = 16 + 9\sqrt{2}$$

Ans: (D) $16 + 9\sqrt{2}$

11. A rationalising factor of $18 + \sqrt{22}$ is

$$(18 + \sqrt{22})(18 - \sqrt{22}) = 302, \text{ a rational number.}$$

None of the other products is rational.

Ans: (B) $18 - \sqrt{22}$

12. The rationalising factor of $\sqrt[3]{9} - \sqrt[3]{7}$ is

$$\text{Use } (x - y)(x^2 + xy + y^2) = x^3 - y^3 \text{ with } x = \sqrt[3]{9}, y = \sqrt[3]{7}.$$

$$\text{Rationalising factor: } (\sqrt[3]{9})^2 + \sqrt[3]{9} \cdot \sqrt[3]{7} + (\sqrt[3]{7})^2$$

$$\text{Product} = (\sqrt[3]{9})^3 - (\sqrt[3]{7})^3 = 9 - 7 = 2$$

Ans: (D) $(\sqrt[3]{9})^2 + \sqrt[3]{9} \cdot \sqrt[3]{7} + (\sqrt[3]{7})^2$

13. $\sqrt{32} + \sqrt{128} =$

$$\sqrt{32} = \sqrt{16 \times 2} = 4\sqrt{2}$$

$$\sqrt{128} = \sqrt{64 \times 2} = 8\sqrt{2}$$

$$4\sqrt{2} + 8\sqrt{2} = 12\sqrt{2} \text{ (add like surds)}$$

Ans: (C) $12\sqrt{2}$

14. $(5\sqrt{5})^3 =$

$$(5\sqrt{5})^3 = 5^3 \times (\sqrt{5})^3 = 125 \times 5\sqrt{5} = 625\sqrt{5}$$

Ans: (B) $625\sqrt{5}$

15. $(\sqrt{6} - \sqrt{5})^2 =$

$$(\sqrt{6} - \sqrt{5})^2 = 6 + 5 - 2\sqrt{30} = 11 - 2\sqrt{30}$$

Ans: (C) $11 - 2\sqrt{30}$

16. $(9 + 5\sqrt{3})(9 - 5\sqrt{3}) =$

$$(a + b)(a - b) = a^2 - b^2$$

$$= 9^2 - (5\sqrt{3})^2 = 81 - 75 = 6$$

Ans: (D) 6

17. $\frac{1}{6 - \sqrt{7}} =$

$$\text{Multiply above and below by } 6 + \sqrt{7}: (6 - \sqrt{7})(6 + \sqrt{7}) = 36 - 7 = 29$$

$$= \frac{6 + \sqrt{7}}{29}$$

Ans: (A) $\frac{6 + \sqrt{7}}{29}$

18. Rationalising the denominator of $\frac{1}{\sqrt{15}+\sqrt{3}}$ gives

Multiply above and below by $\sqrt{15} - \sqrt{3}$: $(\sqrt{15} + \sqrt{3})(\sqrt{15} - \sqrt{3}) = 15 - 3 = 12$

$$= \frac{\sqrt{15}-\sqrt{3}}{12}$$

Ans: (C) $\frac{\sqrt{15}-\sqrt{3}}{12}$

19. If $\frac{6+5\sqrt{2}}{3-\sqrt{2}} = a + b\sqrt{2}$, then $b =$

$$\frac{6+5\sqrt{2}}{3-\sqrt{2}} = \frac{(6+5\sqrt{2})(3+\sqrt{2})}{(3-\sqrt{2})(3+\sqrt{2})}$$

$$\text{Numerator: } 18 + 6\sqrt{2} + 15\sqrt{2} + 10 = 28 + 21\sqrt{2}$$

$$\text{Denominator: } 3^2 - (\sqrt{2})^2 = 9 - 2 = 7$$

$$\frac{28+21\sqrt{2}}{7} = 4 + 3\sqrt{2}$$

So $a = 4$, $b = 3$

Ans: (D) 3

20. $\frac{2+\sqrt{14}}{2-\sqrt{14}} + \frac{2-\sqrt{14}}{2+\sqrt{14}} =$

$$= \frac{(2+\sqrt{14})^2 + (2-\sqrt{14})^2}{(2+\sqrt{14})(2-\sqrt{14})} = \frac{36}{-10} = -\frac{18}{5}$$

The $\sqrt{14}$ terms cancel and $(2 + \sqrt{14})(2 - \sqrt{14}) = -10$.

Ans: (A) $-\frac{18}{5}$

21. $\frac{1}{4+\sqrt{13}} + \frac{1}{4-\sqrt{13}} =$

$$= \frac{(4-\sqrt{13})+(4+\sqrt{13})}{(4+\sqrt{13})(4-\sqrt{13})} = \frac{8}{3}$$

Ans: (A) $\frac{8}{3}$

22. If $x = \sqrt[3]{8 - 3\sqrt{7}}$, then $x^3 + \frac{1}{x^3} =$

$$x^3 = 8 - 3\sqrt{7}, \text{ so } \frac{1}{x^3} = \frac{1}{8-3\sqrt{7}} = 8 + 3\sqrt{7}$$

$$x^3 + \frac{1}{x^3} = (8 - 3\sqrt{7}) + (8 + 3\sqrt{7}) = 16$$

Ans: (B) 16

23. If $x = 3 + 2\sqrt{2}$, then $x^2 - 6x =$

$$x - 3 = 2\sqrt{2}, \text{ so } (x - 3)^2 = 8$$

$$x^2 - 6x + 9 = 8, \text{ so } x^2 - 6x = -1$$

Ans: (B) -1

24. $\sqrt{13 - \sqrt{168}} =$

$$\sqrt{168} = \sqrt{4 \times 42} = 2\sqrt{42}$$

$$\sqrt{13 - \sqrt{168}} = \sqrt{7 + 6 - 2\sqrt{7 \times 6}}$$

$$= \sqrt{(\sqrt{7})^2 + (\sqrt{6})^2 - 2(\sqrt{7})(\sqrt{6})}$$

$$= \sqrt{(\sqrt{7} - \sqrt{6})^2} = \sqrt{7} - \sqrt{6}$$

Ans: (A) $\sqrt{7} - \sqrt{6}$

25. $\sqrt{14 + \sqrt{171}} =$

$$\begin{aligned}\sqrt{14 + \sqrt{171}} &= \sqrt{\frac{2(14 + \sqrt{171})}{2}} = \frac{\sqrt{28 + 2\sqrt{171}}}{\sqrt{2}} \\&= \frac{\sqrt{19+9+2\sqrt{19 \times 9}}}{\sqrt{2}} \\&= \frac{\sqrt{(\sqrt{19})^2 + (3)^2 + 2(\sqrt{19})(3)}}{\sqrt{2}} \\&= \frac{\sqrt{(\sqrt{19}+3)^2}}{\sqrt{2}} = \frac{\sqrt{19}+3}{\sqrt{2}}\end{aligned}$$

Ans: (B) $\frac{\sqrt{19}+3}{\sqrt{2}}$
