Year 9 Worksheet 6: Indices and Surds

Question 1: Answer the following.

(1) What is $3x^5 \times 7x^4$ is equivalent to:

A. $10xx^9$ B. $10x^{25}$ C. $10x^9$ D. $21x^9$ E. $21x^{25}$

(2) Simplify $4(2a^4)^0$.

A. 4 B. $8a^{40}$ C. 8a D. $8a^4$ E. 8

(3) Expand $(5b^3)^2$.

A. $5b^5$ B. $5b^6$ C. $25b^6$ D. $25b^5$ E. $125b$

(4) $49^{\frac{1}{2}}$ is equivalent to:

A. 2401 B. 25.5 C. 9 D. 7 E. 4

(5) What is $\sqrt{3} \times \sqrt{5}$ equivalent to?

A. $\sqrt{8}$ B. $\sqrt{15}$ C. $\sqrt{35}$ D. $1\sqrt{5}$ E. $15\sqrt{1}$

(6) Simplify $3\sqrt{5} + 4\sqrt{7} - \sqrt{5}$

A. $6\sqrt{7}$ B. $8\sqrt{5}$ C. $-4\sqrt{5}\sqrt{7}$ D. $\sqrt{5+7}$ E. $2\sqrt{5} + 4\sqrt{7}$

(7) Simplify $3a^2b \times \frac{a^3b^5}{a^4b^3}$

A. $3a^2b$ B. $3ab^2$ C. $3ab^3$ D. $3a^2b^3$ E. ab^3

(8) $\left(\frac{4x^3y^2}{-y}\right)^2$ is equal to:

A. $16x^9y^2$ B. $-16x^9y^2$ C. $4x^3y^1$ D. $-4x^3y^1$ E. $4x^3$

(9) What is 4.05×10^{-3} in expanded form?

A. 405 B. 0.405 C. 0.045 D. 0.0405 E. 0.00405

(10) What is 0.000730 in expanded form?

A. 7.30×10^3 B. 7.30×10^4 C. 7.3×10^{-3} D. 7.3×10^{-4}

Question 2: Answer the following.

1	Simplify the following. a. $-x^4 \times x^5$ b. $3pq^5 \times 8q^2p^6$ c. $7a^5b^6b \div ab^5$ d. $2ab^3c^5 \times 3a^2b^2c \div 9a^2b^4c$

2	For the following expression, write them with positive indices. a. $(4u^3)^{-2}$ b. $\frac{3}{5}m^3n^{-5}$ c. $\frac{2^3}{y^{-3}}$ d. $2\left(\frac{p^3}{q^{-2}}\right)^{-3}$

3	Simplify the following. a. $\frac{2a^3c^2}{b^2} \times \frac{b^3a^0}{6c^2}$ b. $\left(\frac{3a^1b^0}{c^0b^{-1}}\right)^3 \times \frac{c^3a^2b}{9a^3c}$ c. $\left(\frac{2c^2b^{-1}}{a^3b^2}\right)^4 \div \frac{\left(b^{-2}c^3a\right)^2}{4c^4}$
4	Evaluate the following without using a calculator. a. $\sqrt[3]{64}$

b. $\sqrt[5]{32}$

c. $25^{\frac{1}{2}}$

d. $81^{\frac{1}{4}}$

e. $9^{\frac{-1}{2}}$

f. $27^{-\frac{1}{3}}$

5	Simplify the following operations with surds. a. $8\sqrt{5} - 3\sqrt{5}$ b. $2\sqrt{3} - 4\sqrt{7} + 3\sqrt{3} + 8\sqrt{7} - \sqrt{3}$ c. $3\sqrt{5} \times \sqrt{7}$ d. $4\sqrt{11} \times 6\sqrt{3}$ e. $\sqrt{72} \div \sqrt{8}$ f. $\sqrt{48} \div 3\sqrt{6}$

6	Convert the following values in decimal form. a. 5.73×10^{4} = _____ b. 1.425×10^{2} = _____ c. 2.938×10^{-3} = _____ d. 3.82×10^{-1} = _____
7	Simplify the following using a combination of index laws. a. $\frac{2a^{2}c^{4}\times c^{0}a^{2}b}{8b^{5}}\times\frac{4b^{3}a^{-1}}{2c^{5}}$ b. $\left(\frac{3a^{3}b^{4}c^{-5}}{9c^{-3}b^{3}a}\right)^{-2}\div\frac{3c^{4}a^{3}b}{9a^{5}b^{-2}c^{2}}$

	c. $\left(\frac{2c^2b^{-1}}{a^3b^2}\right)^0 \times \frac{\left(b^{\frac{1}{2}}c^{\frac{3}{2}}a\right)^2}{\left(4c^4\right)^{\frac{1}{4}}} \div \frac{\left(b^{-2}c^{-1}a\right)^3}{4ba^5}$
8	Convert the following and express them in terms of scientific notation. a. 18 years = _____ hours b. 950 microseconds = _____ seconds c. 50 seconds = _____ days d. 75 days = _____ minutes

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Answer Key

Question 1: Answer the following.

(1) What is $3x^5 \times 7x^4$ is equivalent to:

A. $10xx^9$ B. $10x^{25}$ C. $10x^9$ D. $21x^9$ E. $21x^{25}$

Answer: D. $21x^9$

(2) Simplify $4(2a^4)^0$.

A. 4 B. $8a^{40}$ C. 8a D. $8a^4$ E. 8

Answer: A. 4

(3) Expand $(5b^3)^2$.

A. $5b^5$ B. $5b^6$ C. $25b^6$ D. $25b^5$ E. 125b

Answer: C. $25b^6$

(4) $49^{½}$ is equivalent to:

A. 2401 B. 25.5 C. 9 D. 7 E. 4

Answer: D. 7

(5) What is $\sqrt{3} \times \sqrt{5}$ equivalent to?

A. $\sqrt{8}$ B. $\sqrt{15}$ C. $\sqrt{35}$ D. $1\sqrt{5}$ E. $15\sqrt{1}$

Answer: B. $\sqrt{15}$

(6) Simplify $3\sqrt{5} + 4\sqrt{7} - \sqrt{5}$

A. $6\sqrt{7}$ B. $8\sqrt{5}$ C. $-4\sqrt{5}\sqrt{7}$ D. $\sqrt{5+7}$ E. $2\sqrt{5} + 4\sqrt{7}$

Answer: E. $2\sqrt{5} + 4\sqrt{7}$

(7) Simplify $3a^2b \times \frac{a^3b^5}{a^4b^3}$

A. $3a^2b$ B. $3ab^2$ C. $3ab^3$ D. $3a^2b^3$ E. ab^3

Answer: C. $3ab^3$

(8) $\left(\frac{4x^3y^2}{-y}\right)^2$ is equal to:

A. $16x^9y^2$ B. $-16x^9y^2$ C. $4x^3y^1$ D. $-4x^3y^1$ E. $4x^3$

Answer: A. $16x^9y^2$

(9) What is 4.05×10^{-3} in expanded form?

A. 405 B. 0.405 C. 0.045 D. 0.0405 E. 0.00405

Answer: E. 0.00405

(10) What is 0.000730 in expanded form?

A. 7.30×10^3 B. 7.30×10^4 C. 7.3×10^{-3} D. 7.3×10^{-4}

Answer: D. 7.3×10^{-4}

Question 2: Answer the following.

1	Simplify the following. a. $-x^4 \times x^5$ $= -x^9$ b. $3pq^5 \times 8q^2p^6$ $= 24q^7p^7$ c. $7a^5b^6b \div ab^5$ $= 7a^4b^2$ d. $2ab^3c^5 \times 3a^2b^2c \div 9a^2b^4c$ $= \frac{2}{3}a^1b^1c^5$
2	For the following expression, write them with positive indices. a. $(4u^3)^{-2} = 1/(16u^6)$ b. $\frac{3}{5}m^3n^{-5} = \frac{3m^3n^5}{5}$ c. $\frac{2^3}{y^{-3}} = (2y)^3$ d. $2\left(\frac{p^3}{q^{-2}}\right)^{-3} = 2/(p^9q^6)$

3 Simplify the following.

a. $\frac{2a^3c^2}{b^2} \times \frac{b^3a^0}{6c^2}$

Apply the fraction rule: $\frac{a}{b} \cdot \frac{c}{d} = \frac{a \cdot c}{b \cdot d}$

$= \frac{2a^3c^2b^3}{b^2 \cdot 6c^2}$

Cancel the common factor: c^2

$= \frac{2a^3b^3}{b^2 \cdot 6}$

Factor the number: $6 = 2 \cdot 3$

$= \frac{2a^3b^3}{b^2 \cdot 2 \cdot 3}$

Cancel the common factor: 2

$= \frac{a^3b^3}{b^2 \cdot 3}$

Simplify $\frac{b^3}{b^2}$: b

$= \frac{a^3b}{3}$

b. $\left(\frac{3a^1b^0}{c^0b^{-1}}\right)^3 \times \frac{c^3a^2b}{9a^3c}$

Simplify $\left(\frac{3a}{b^{-1}}\right)\left(\frac{c^3a^2b}{9a^3c}\right)$: $\frac{3a}{b^{-1}} \cdot \frac{c^3a^2b}{9a^3c}$

$= \frac{3a}{b^{-1}} \cdot \frac{c^3a^2b}{9a^3c}$

Simplify $\frac{3a}{b^{-1}}$: $3ab$

$= 3ab\frac{c^3a^2b}{9a^3c}$

Cancel $\frac{c^3a^2b}{9a^3c}$: $\frac{c^2b}{9a}$

$= 3ab\frac{c^2b}{9a}$

Apply the fraction rule: $a \cdot \frac{b}{c} = \frac{a \cdot b}{c}$

$= \frac{3abc^2b}{9a}$

Apply exponent rule: $aa = a^2$

$bb = b^2$

$= \frac{3ab^2c^2}{9a}$

Cancel the common factor: a

$= \frac{3b^2c^2}{9}$

Factor the number: $9 = 3 \cdot 3$

$= \frac{3b^2c^2}{3 \cdot 3}$

Cancel the common factor: 3

$= \frac{b^2c^2}{3}$

c. $\left(\frac{2c^2b^{-1}}{a^3b^2}\right)^4 \div \frac{(b^{-2}c^3a)^2}{4c^4}$

Apply the fraction rule: $\frac{\frac{a}{b}}{c} = \frac{a \cdot c}{b}$

$= \frac{\left(\frac{2c^2b^{-1}}{a^3b^2}\right)^4 \cdot 4c^4}{(b^{-2}c^3a)^2}$

Simplify $\left(\frac{2c^2b^{-1}}{a^3b^2}\right)^4 \cdot 4c^4$: $\frac{64c^{12}}{b^{12}a^{12}}$

$= \frac{\frac{64c^{12}}{b^{12}a^{12}}}{(b^{-2}c^3a)^2}$

Apply the fraction rule: $\frac{\frac{a}{b}}{c} = \frac{a}{b \cdot c}$

$= \frac{64c^{12}}{b^{12}a^{12}(b^{-2}c^3a)^2}$

Simplify $b^{12}a^{12}(b^{-2}c^3a)^2$: $b^8a^{14}c^6$

$= \frac{64c^{12}}{b^8a^{14}c^6}$

Cancel $\frac{64c^{12}}{b^8a^{14}c^6}$: $\frac{64c^6}{b^8a^{14}}$

$= \frac{64c^6}{b^8a^{14}}$

4 Evaluate the following without using a calculator.

a. $\sqrt[3]{64} = 4$

$\sqrt[3]{64}$

Factor the number: $64 = 4^3$

$= \sqrt[3]{4^3}$

Apply radical rule: $\sqrt[n]{a^n} = a, \quad a \geq 0$

$\sqrt[3]{4^3} = 4$

$= 4$

b. $\sqrt[5]{32} = 2$

$\sqrt[5]{32}$

Factor the number: $32 = 2^5$

$= \sqrt[5]{2^5}$

Apply radical rule: $\sqrt[n]{a^n} = a, \quad a \geq 0$

$\sqrt[5]{2^5} = 2$

$= 2$

c. $25^{\frac{1}{2}} = 5$

Apply exponent rule: $(a^b)^c = a^{bc}$,

$= 5^{2 \cdot \frac{1}{2}}$

$2 \cdot \frac{1}{2} = 1$

$= 5^1$

Apply exponent rule: $a^1 = a$

$= 5$

d. $81^{\frac{1}{4}} = 3$

Apply exponent rule: $(a^b)^c = a^{bc}$

$= 3^{4 \cdot \frac{1}{4}}$

$4 \cdot \frac{1}{4} = 1$

$= 3^1$

Apply exponent rule: $a^1 = a$

$= 3$

e. $9^{\frac{-1}{2}} = 1/3$

Apply exponent rule: $(a^b)^c = a^{bc}$

$= 3^{2 \cdot \frac{1}{-2}}$

$2 \cdot \frac{1}{-2} = -1$

$= 3^{-1}$

Apply exponent rule: $a^{-1} = \frac{1}{a}$

$3^{-1} = \frac{1}{3}$

$= \frac{1}{3}$

f. $27^{-\frac{1}{3}} = 1/3$

Apply exponent rule: $(a^b)^c = a^{bc}$,

$= 3^{3 \cdot \frac{1}{-3}}$

$3 \cdot \frac{1}{-3} = -1$

$= 3^{-1}$

Apply exponent rule: $a^{-1} = \frac{1}{a}$

$3^{-1} = \frac{1}{3}$

$= \frac{1}{3}$

5	Simplify the following operations with surds. a. $8\sqrt{5} - 3\sqrt{5}$ = $5\sqrt{5}$ b. $2\sqrt{3} - 4\sqrt{7} + 3\sqrt{3} + 8\sqrt{7} - \sqrt{3}$ = $4\sqrt{7} + 4\sqrt{3}$ c. $3\sqrt{5} \times \sqrt{7}$ = $3\sqrt{35}$ d. $4\sqrt{11} \times 6\sqrt{3}$ = $24\sqrt{33}$ e. $\sqrt{72} \div \sqrt{8}$ = $\sqrt{9}$ f. $\sqrt{48} \div 3\sqrt{6}$ = $1/(3\sqrt{8})$ or $2\sqrt{2}/3$
6	Convert the following values in decimal form. a. 5.73×10^{4} = 57300 b. 1.425×10^{2} = 142.5 c. 2.938×10^{-3} = 0.002938 d. 3.82×10^{-4} = 0.000382

7 Simplify the following using a combination of index laws.

a. $\frac{2a^2c^4\times c^0a^2b}{8b^5}\times\frac{4b^3a^{-1}}{2c^5}$

$$=\frac{2a^2c^4c^0a^2b}{8b^5}\cdot\frac{4b^3a^{-1}}{2c^5}$$

Cancel $\frac{2a^2c^4c^0a^2b}{8b^5}$: $\frac{a^4c^4}{4b^4}$

$$=\frac{a^4c^4}{4b^4}\cdot\frac{4b^3a^{-1}}{2c^5}$$

Cancel $\frac{4b^3a^{-1}}{2c^5}$: $\frac{2b^3}{ac^5}$

$$=\frac{a^4c^4}{4b^4}\cdot\frac{2b^3}{ac^5}$$

Apply the fraction rule: $\frac{a}{b}\cdot\frac{c}{d}=\frac{a\cdot c}{b\cdot d}$

$$=\frac{a^4c^4\cdot 2b^3}{4b^4ac^5}$$

Factor the number: $4=2\cdot 2$

$$=\frac{a^4c^4\cdot 2b^3}{2\cdot 2b^4ac^5}$$

Cancel the common factor: 2

$$=\frac{a^4c^4b^3}{2b^4ac^5}$$

Simplify $\frac{a^4}{a}$: a^3

$$=\frac{a^3c^4b^3}{2b^4c^5}$$

Simplify $\frac{c^4}{c^5}$: $\frac{1}{c}$

$$=\frac{a^3b^3}{2b^4c}$$

Simplify $\frac{b^3}{b^4}$: $\frac{1}{b}$

$$=\frac{a^3}{2bc}$$

b. $\left(\frac{3a^3b^4c^{-5}}{9c^{-3}b^3a}\right)^{-2} \div \frac{3c^4a^3b}{9a^5b^{-2}c^2}$

Apply the fraction rule: $\frac{\frac{a}{b}}{c} = \frac{a \cdot c}{b}$

$$= \frac{\left(\frac{3a^3b^4c^{-5}}{9c^{-3}b^3a}\right)^{-2} \cdot 9a^5b^{-2}c^2}{3c^4a^3b}$$

Cancel $\frac{\left(\frac{3a^3b^4c^{-5}}{9c^{-3}b^3a}\right)^{-2} \cdot 9a^5b^{-2}c^2}{3c^4a^3b} : \frac{27c^2}{a^2b^5}$

$$= \frac{27c^2}{a^2b^5}$$

c. $\left(\frac{2c^2b^{-1}}{a^3b^2}\right)^0 \times \frac{\left(b^{\frac{1}{2}}c^{\frac{3}{2}}a\right)^2}{\left(4c^4\right)^{\frac{1}{4}}} \div \frac{\left(b^{-2}c^{-1}a\right)^3}{4ba^5}$

Apply exponent rule: $a^0 = 1$, assuming $a \neq 0$

$\left(\frac{2c^2b^{-1}}{a^3b^2}\right)^0 = 1$

$= 1 \cdot \frac{\frac{\left(b^{\frac{1}{2}}c^{\frac{3}{2}}a\right)^2}{\left(4c^4\right)^{\frac{1}{4}}}}{\frac{\left(b^{-2}c^{-1}a\right)^3}{4ba^5}}$

Apply rule: $1 \cdot a = a$

$= \frac{\frac{\left(b^{\frac{1}{2}}c^{\frac{3}{2}}a\right)^2}{\left(4c^4\right)^{\frac{1}{4}}}}{\frac{\left(b^{-2}c^{-1}a\right)^3}{4ba^5}}$

Apply the fraction rule: $\frac{\frac{a}{b}}{\frac{c}{d}} = \frac{a \cdot d}{b \cdot c}$

$= \frac{\left(b^{\frac{1}{2}}c^{\frac{3}{2}}a\right)^2 \cdot 4ba^5}{\left(4c^4\right)^{\frac{1}{4}}\left(b^{-2}c^{-1}a\right)^3}$

Cancel $\frac{\left(b^{\frac{1}{2}}c^{\frac{3}{2}}a\right)^2 \cdot 4ba^5}{\left(4c^4\right)^{\frac{1}{4}}\left(b^{-2}c^{-1}a\right)^3}$: $2 \cdot 2^{\frac{1}{2}}c^5b^8a^4$

$= 2 \cdot 2^{\frac{1}{2}}c^5b^8a^4$

8	Convert the following and express them in terms of scientific notation. a. 18 years = 157680 = 1.58×10^{5} hours b. 950 microseconds = 0.00095 = 9.5×10^{-4} seconds c. 50 seconds = 0.000578704 = 5.79×10^{-4} days d. 75 days = 108000 = 1.08×10^{5} minutes