

REVIEW BOOKLET

QUESTION 1

Perform the following multiplications by applying the laws of exponents. Make sure that your answers contain only positive exponents. Show all the steps in the solution.

a) $(32a^{-3}b^2)^{-2} \times (-4a^4b^{-2})^5$

b) $(-3p^{-4}q^2)^2 \times (9p^3q^{-5})^{-1}$

c) $(-2a^2b^{-5})^4 \times (4a^{-3}b^2)^{-2}$

d) $(xy^2z^2)^{-5} \times (x^6y^{-1}z)^{\frac{5}{6}}$

e) $\left(\frac{9}{b}\right)^{-3} \times \left(\frac{b^3}{27}\right)^{-2}$

f) $\left(\frac{x^2}{125}\right)^{-3} \times \left(\frac{625}{x^3}\right)^{-2}$

QUESTION 2

Perform the following divisions by applying the laws of exponents. Make sure your answers contain only positive exponents. Show all the steps in the solutions.

a)
$$\left(-16x^{-3}yx^4\right)^4 \div \left(32y^{\frac{1}{4}}x^4\right)^{-4}$$

b)
$$\left(-27ab^{-3}a^2\right)^7 \div \left(81b^4a^{\frac{1}{5}}\right)^5$$

c) $(-s^8 t^{-3})^{-1} \div (5^{\frac{1}{3}} t^{\frac{1}{2}} u^{-1})^6$

d) $\left(\frac{9}{p^4}\right)^3 \div \left(\frac{p^5}{27}\right)^{-2}$

QUESTION 3

Simplify the following expressions. Make sure your answers contain only positive exponents. Show all the steps in the solutions.

a) $\left(\frac{-2x^3y^{-4}}{16^4x^{-2}y^3}\right)^{-2}$

b) $\left(\frac{36^2m^3n^{-1}}{-6m^{-2}n^4}\right)^{-4}$

c)
$$\left(\frac{m^{\frac{4}{7}} n^{-3} o^4}{27 m^{-1} n^4} \right)^{-2}$$

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

QUESTION 4

Perform the following multiplications and divisions by using scientific notation and the laws of exponents. Express your answers in scientific notation. Show all the steps in the solutions.

a)
$$\frac{0.000\ 000\ 3}{4 \times 10^3}$$

b)
$$6 \times 10^{-3} \times 0.000\ 002$$

c) $\frac{0.000\ 004}{5 \times 10^3}$

d) $8 \times 10^{-9} \times 0.000\ 08$

QUESTION 5

For each question, determine whether or not the two expressions are equivalent by applying the laws of exponents. Show all the steps in the solutions.

a) $\left(\frac{8}{9}\right)^{-7} \times \left(\frac{16}{9}\right)^2 \times \left(\frac{32}{81}\right)^3$ and $\left(\frac{2}{3}\right)^8 \times \left(\frac{4}{9}\right)^5 \times \left(\frac{16}{81}\right)^{-4}$

b) $\left(\frac{25}{3}\right)^{-3} \times \left(\frac{125}{81}\right)^3 \times \left(\frac{27}{25}\right)^4$ and $\left(\frac{625}{27}\right)^{-2} \times \left(\frac{25}{9}\right)^6 \times \left(\frac{27}{125}\right)^3$

c) $\left(\frac{5}{4}\right)^{-2} \times \left(\frac{2}{25}\right)^3 \times \left(\frac{125}{16}\right)^{-3}$ and $\left(\frac{8}{5}\right)^3 \times \left(\frac{2}{125}\right)^4 \times \left(\frac{625}{16}\right)^{-1}$

d) $\left(\frac{9}{4}\right)^{-2} \times \left(\frac{3}{2}\right)^{-5} \times \left(\frac{2}{3}\right)^3$ and $\left(\frac{16}{81}\right)^{-1} \times \left(\frac{27}{8}\right) \times \left(\frac{3}{2}\right)^5$

QUESTION 6

- a) If m is an odd negative integer, determine whether the following statements are true or false by replacing the variable with the number of your choice.

<p>A) $\left(-\frac{1}{4}\right)^m \geq 4$</p> <p>True <input type="checkbox"/> or False <input type="checkbox"/></p>	<p>B) $4m > 0$</p> <p>True <input type="checkbox"/> or False <input type="checkbox"/></p>
<p>C) $\left(\frac{1}{4}\right)^{-m} > \frac{1}{4}$</p> <p>True <input type="checkbox"/> or False <input type="checkbox"/></p>	<p>D) $\frac{1}{4^m} > 0$</p> <p>True <input type="checkbox"/> or False <input type="checkbox"/></p>

- b) If m is an even positive integer, determine whether the following statements are true or false by replacing the variable with the number of your choice.

A) $5^{-m} > 0$	B) $\left(-\frac{1}{5}\right)^m \geq \frac{1}{5}$
True <input type="checkbox"/> or False <input type="checkbox"/>	True <input type="checkbox"/> or False <input type="checkbox"/>
C) $(-5)^m \geq 5$	D) $\left(\frac{1}{5}\right)^{-m} \leq \frac{1}{5}$
True <input type="checkbox"/> or False <input type="checkbox"/>	True <input type="checkbox"/> or False <input type="checkbox"/>

- c) If $-1 < a < 0$, determine whether the following statements are true or false by replacing the variable with the number of your choice.

A) $\left(\frac{-1}{a^{-3}}\right)^2 > 0$

True or False

B) $\left(\frac{1}{-a}\right)^3 < \frac{1}{a}$

True or False

C) $a < a^2 < 1$

True or False

D) $(-a)^{-3} < 0$

True or False

- d) If $0 < a < 1$, determine whether the following statements are true or false by replacing the variable with the number of your choice.

A) $\left(\frac{1}{a}\right)^2 > (-a)^{-1}$

True or False

B) $\left(\frac{-1}{a^2}\right)^3 < 0$

True or False

C) $\frac{(-a)^{-2}}{-a^2} < 0$

True or False

D) $a < 1 < a^{-3}$

True or False

QUESTION 7

For each problem given (i.e. on each of this and the next three pages), circle the algebraic expressions that are equivalent. In the spaces provided under each expression, show how you arrived at your conclusion.

a)

$216b^3$	$\frac{6^2}{6^{-1}}b^3$	$\frac{1}{(6^3b^3)^{-1}}$
$\frac{6}{b^{-3}}$	$(6b)^3$	$\frac{6}{-(36b^3)}$

b)

$-s^6 t^8$	$-s^2 t^4 \times s^4 t^4$	$\frac{-s^6}{(t^{-2})^{-4}}$
$\frac{-t^8}{s^{-6}}$	$(s^3 t^{-4})^2$	$s^6 t^5 \times t^3$

c)

$-c^8 d^{12}$	$\frac{-d^{12}}{c^{-8}}$	$-c^2 d^6 \times c^4 d^6$
$-(c^2 d^{-3})^4$	$\frac{-c^8}{(d^{-6})^2}$	$-c^8 d^3 \times d^4$

d)

$16x^4$	$\frac{2x}{-(2^3 x^3)}$	$(2x)^4$
$\frac{1}{(2^2 x^2)^{-2}}$	$\frac{2^2}{2^{-2}} x^4$	$\frac{2}{x^{-4}}$

QUESTION 8

Perform the operations indicated in the expressions below and simplify your answers.
Show all the steps in the solutions.

a) $4\sqrt{2} + \sqrt{18} - \sqrt{72}$

b) $3\sqrt{3} + \sqrt{12} - \sqrt{108}$

c) $\sqrt{12} - \sqrt{9} + \sqrt{27}$

d) $\sqrt{54} + \sqrt{1} - \sqrt{96}$

e) $3\sqrt{5} - \sqrt{180} + \sqrt{45}$

QUESTION 9

Perform the operations indicated in the expressions below and simplify your answers.
Show all the steps in the solutions.

a) $(3\sqrt{5} - 3) \cdot (\sqrt{5} + 1)$

b) $(-3\sqrt{27} - 2) \cdot (3\sqrt{3} + 4)$

c) $(3\sqrt{3} + 4) \cdot (\sqrt{3} - 2)$

d) $(5\sqrt{5} + 4) \cdot (-2\sqrt{20} - 3)$

e) $(5\sqrt{5} - 3) \cdot (\sqrt{5} + 5)$

QUESTION 10

Perform the operations indicated in the following expressions. Simplify your answers and rationalize the denominators, if necessary. Show all the steps in the solutions..

a)
$$\frac{-4\sqrt{40}}{\sqrt{32}}$$

b)
$$\frac{6\sqrt{108}}{-5\sqrt{98}}$$

c) $\frac{-\sqrt{72}}{\sqrt{75}}$

d) $\frac{7\sqrt{20}}{-2\sqrt{27}}$

e) $\frac{-2\sqrt{24}}{\sqrt{18}}$

QUESTION 11

Perform the operations indicated in the following expressions. Simplify your answers and rationalize the denominators, if necessary. Show all the steps in the solutions.

a) $\frac{2\sqrt{5}}{3\sqrt{5}-1}$

b) $\frac{-4\sqrt{7}}{4\sqrt{2}+8}$

c) $\frac{-5\sqrt{2}}{2\sqrt{6}+6}$

d) $\frac{6\sqrt{2}}{3\sqrt{2}-6}$

e) $\frac{-2\sqrt{5}}{3\sqrt{3}+7}$

QUESTION 12

For each question, determine whether or not the two expressions are equivalent. Show all the steps in the solutions.

a) $(4\sqrt{3} + 2)(3\sqrt{15} - 4)$ and $2\sqrt{5}(\sqrt{3} + 18) + 2\sqrt{3}(2\sqrt{5} - 8) - 8$

b) $(5\sqrt{2} + 3)(4\sqrt{6} - 2)$ and $2\sqrt{2}(\sqrt{3} - 5) + 5\sqrt{3}(2\sqrt{2} + 8) - 6$

c) $(4 - 2\sqrt{3}) \cdot (3\sqrt{3} + 6)$ and $2\sqrt{5} + 18 - \sqrt{20} - 12$

d) $(6 - \sqrt{5}) \cdot (2\sqrt{5} + 3)$ and $\sqrt{45} + 20 + 7\sqrt{5} - 2$

QUESTION 13

For each question, determine whether or not the two expressions are equivalent by converting them to exponential form. Show all the steps in the solutions.

a) $x^{\frac{5}{3}}\sqrt{x^4}$ and $\left(\frac{1}{x}\right)^{\frac{-7}{3}} \cdot \sqrt[3]{x^4}$

b) $x^2\sqrt{\left(\frac{1}{x}\right)^{-7}}$ and $(x^4)^{\frac{1}{2}} \cdot \sqrt[4]{x^{10}}$

c) $b^{\frac{5}{4}}\sqrt{b^2}$ and $\left(\frac{1}{b}\right)^{\frac{-3}{4}} \cdot \sqrt[4]{b^4}$

d) $a^2\sqrt{\left(\frac{1}{a}\right)^{-5}}$ and $(a^2)^{\frac{3}{2}} \cdot \sqrt{a^3}$

e) $y^{\frac{9}{2}}\sqrt{y}$ and $\left(\frac{1}{y}\right)^{\frac{-5}{3}} \cdot \sqrt[3]{y^{10}}$

QUESTION 14

Simplify the following expressions. For this question, please convert exponent answers to radical form. Rationalize the denominators, if necessary.

a) $\frac{3^{\frac{5}{2}}}{3}$

b) $\frac{7}{4}\sqrt{80}$

c) $2\sqrt{7} \times -\sqrt{7}$

d) $\frac{1}{2\sqrt{5}}$

e) $\frac{\sqrt{50}}{5\sqrt{3}}$

f) $5\sqrt{7} - \sqrt{7}$

g) $\frac{1}{\frac{-5}{7^2}}$

h) $\frac{7^{\frac{3}{2}}}{7}$

i) $\frac{5}{\sqrt{7}}$

j) $\frac{1}{\frac{-3}{7^2}}$

k) $4\sqrt{3} \times -2\sqrt{3}$

l) $\frac{3}{\sqrt{5}}$

Answers (Rev booklet Exponents + Radicals)

1. a) $\frac{-a^{26}}{b^{14}}$

2. a) $2^{36} x^{20} y^3$

3. a) $\frac{2^{30} y^{14}}{x^{10}}$

b) $\frac{a^9}{p^{11}}$

b) $\frac{-3a^{22}}{b^{41}}$

b) $\frac{n^{20}}{6^{12} m^{20}}$

c) $\frac{a^{14}}{b^{24}}$

c) $\frac{-u^6}{5^2 s^8}$ OR $\frac{-u^6}{25 s^8}$

c) $\frac{3^6 n^{14}}{m^{\frac{22}{7}} o^8}$

d) $\frac{1}{y^{\frac{65}{6}} z^{\frac{55}{6}}}$

d) $\frac{1}{p^2}$

d) $\frac{-3^9 b^{21}}{a^{24}}$

e) $\frac{1}{b^3}$

4. a) 7.5×10^{-11}

5. a) $\frac{2^2}{3^2} = \frac{2^2}{3^2}$

f) 5

b) 1.2×10^{-8}

b) $\frac{3^3}{5^5} = \frac{3^3}{5^5}$

c) 8×10^{-10}

c) $\frac{2^{19}}{5^{17}} \neq \frac{2^{17}}{5^{19}}$

d) 6.4×10^{-13}

d) $\frac{2^{12}}{3^{12}} \neq \frac{3^{12}}{2^{12}}$

6. a) A) F
B) F
C) F
D) T

b) A) T
B) F
C) T
D) F

c) A) T
B) F
C) T
D) F

d) A) T
B) T
C) T
D) T

7. a) $216b^3, \frac{6^2}{6^{-1}}b^3, \frac{1}{(6^3 b^3)^{-1}}, (6b)^3$ } should all be circled (all = $6^3 b^3$)

b) $-s^6 t^8, -s^2 t^4 \times s^4 t^4, \frac{-t^8}{s^{-6}}$ } should all be circled

c) $-c^8 d^{12}, \frac{-d^{12}}{c^{-8}}, \frac{-c^8}{(d^{-6})^2}$ } should all be circled

d) $16x^4, (2x)^4, \frac{1}{(2^2 x^2)^{-2}}, \frac{2^2}{2^{-2}} x^4$ } should all be circled (all = $2^4 x^4$)

8. a) $\sqrt{2}$
 b) $-\sqrt{3}$
 c) $5\sqrt{3}-3$
 d) $1-\sqrt{6}$
 e) 0

11. d) $-2\sqrt{2}-2$
 e) $\frac{3\sqrt{15}-7\sqrt{5}}{11}$

12. a) Both are equivalent to:
 $36\sqrt{5}-16\sqrt{3}+6\sqrt{15}-8$

9. a) 12
 b) $-89-42\sqrt{3}$
 c) $1-2\sqrt{3}$
 d) $-112-31\sqrt{5}$
 e) $10+22\sqrt{5}$

b) Both are equivalent to:
 $40\sqrt{3}-10\sqrt{2}+12\sqrt{6}-6$

c) Both are equivalent to:
 $12\sqrt{3}+24-18-12\sqrt{3}$

10. a) $-2\sqrt{5}$
 b) $\frac{-18\sqrt{6}}{35}$
 c) $\frac{-2\sqrt{6}}{5}$
 d) $\frac{-7\sqrt{15}}{9}$
 e) $\frac{-4\sqrt{3}}{3}$

d) They are not equivalent.
 1st one = $9\sqrt{5}+8$
 2nd one = $10\sqrt{5}+18$

13. a) $x^{\frac{11}{3}} = x^{\frac{11}{3}}$
 b) $x^{\frac{11}{2}} \neq x^{\frac{9}{2}}$
 c) $b^{\frac{9}{4}} \neq b^{\frac{11}{2}}$
 d) $a^{\frac{9}{2}} = a^{\frac{9}{2}}$
 e) $y^5 = y^5$

11. a) $\frac{\sqrt{5}+15}{22}$
 b) $\frac{\sqrt{14}-2\sqrt{7}}{2}$
 c) $\frac{5(2\sqrt{3}-3\sqrt{2})}{6}$

14. a) $\sqrt{3^3}$ or $\sqrt{27}$ f) $4\sqrt{7}$
 b) $7\sqrt{5}$ g) $\sqrt{7^5}$
 c) $\sqrt{7}$ h) $\sqrt{7}$
 d) $\frac{\sqrt{5}}{10}$ i) $\frac{5\sqrt{7}}{7}$
 e) $\frac{\sqrt{6}}{3}$ j) $\sqrt{7^3}$
 k) -24 l) $\frac{3\sqrt{5}}{5}$