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Exponents

EXERCISE 5A PAGE: 90

1. **Write each of the following in power notation:**

   i. **(5/7) ×(5/7) × (5/7) × (5/7)**
   Solution:-
   The product of rational number multiplied several times by itself can be expressed in the power notations as,
   $(5/7)^4$

   ii. **(-4/3) ×(-4/3) × (-4/3) × (-4/3) × (-4/3)**
   Solution:-
   The product of rational number multiplied several times by itself can be expressed in the power notations as,
   $(-4/3)^5$

   iii. **(-1/6) ×(-1/6) × (-1/6)**
   Solution:-
   The product of rational number multiplied several times by itself can be expressed in the power notations as,
   $(-1/6)^3$

   iv. **(-8) ×(-8) × (-8) × (-8) × (-8)**
   Solution:-
   The product of rational number multiplied several times by itself can be expressed in the power notations as,
   $(-8)^5$

2. **Express each of the following in power notation:**

   i. **(25/36)**
   Solution:-
   We have,
   $25 = 5 × 5 = (5)^2$
   $36 = 6 × 6 = (6)^2$
   Then,
   $= (5^2/6^2)$
   $∴ (5/6)^2$

   ii. **(-27/64)**
   Solution:-
   We have,
   $-27 = -3 × -3 × -3 = (-3)^3$
   $64 = 4 × 4 × 4 = (4)^3$
   Then,

$$= (-3^3/4^3)$$
$$\therefore (-3/4)^3$$

iii. (-32/243)
Solution:-
We have,

$-32 = -2 \times -2 \times -2 \times -2 \times -2 = (-2)^5$

$243 = 3 \times 3 \times 3 \times 3 \times 3 = (3)^5$

Then,

$$= (-2^5/3^5)$$
$$\therefore (-2/3)^5$$

iv. (-1/128)
Solution:-
We have,

$-1 = -1 \times -1 \times -1 \times -1 \times -1 \times -1 \times -1 = (-1)^7$

$128 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = (2)^7$

Then,

$$= (-1^7/2^7)$$
$$\therefore (-1/2)^7$$

3. **Express each of the following a rational number:**

i. $(2/3)^5$
Solution:-
We have,

$(2/3)^5 = (2^5/3^5)$

$= (2 \times 2 \times 2 \times 2 \times 2) / (3 \times 3 \times 3 \times 3 \times 3)$

$= (32/243)$

ii. $(-8/5)^3$
Solution:-
We have,

$(-8/5)^3 = (-8^3/5^3)$

$= (-8 \times -8 \times -8) / (5 \times 5 \times 5)$

$= (-512/125)$

iii. $(-13/11)^2$
Solution:-
We have,

$(-13/11)^2 = (-13^2/11^2)$

$= (-13 \times -13) / (11 \times 11)$

$= (169/121)$

iv. $(1/6)^3$

Solution:-

We have,

$(1/6)^3 = (1^3/6^3)$

$= (1 \times 1 \times 1) / (6 \times 6 \times 6)$

$= (1/216)$

v. $(-1/2)^5$

Solution:-

We have,

$(-1/2)^5 = (-1^5/2^5)$

$= (-1 \times -1 \times -1 \times -1 \times -1) / (2 \times 2 \times 2 \times 2 \times 2)$

$= (-1/32)$

vi. $(-4/7)^3$

Solution:-

We have,

$(-4/7)^3 = (-4^3/7^3)$

$= (-4 \times -4 \times -4) / (7 \times 7 \times 7)$

$= (-64/343)$

vii. $(-1)^9$

Solution:-

We have,

$(-1)^9 = (-1^9)$

$= (-1 \times -1 \times -1 \times -1 \times -1 \times -1 \times -1 \times -1 \times -1)$

$= (-1)$

4. **Express each of the following as a rational number:**

i. $(4)^{-1}$

Solution:-

We have:

$(4)^{-1} = (4/1)^{-1}$

$= (1/4)^1$ ... $[\because (a/b)^{-n} = (b/a)^n]$

$= (1/4)$

ii. $(-6)^{-1}$

Solution:-

We have:

$(-6)^{-1} = (-6/1)^{-1}$

$= (1/-6)^1$ ... $[\because (a/b)^{-n} = (b/a)^n]$

$= (-1/6)$

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iii. $(1/3)^{-1}$

Solution:-

We have:

$(1/3)^{-1} = (-6/1)^{-1}$

$= (3/1)^1$ ... $[\because (a/b)^{-n} = (b/a)^n]$

$= 3$

iv. $(--2/3)^{-1}$

Solution:-

We have:

$(-2/3)^{-1} = (-2/3)^{-1}$

$= (3/-2)^1$ ... $[\because (a/b)^{-n} = (b/a)^n]$

$= (-3/2)$

5. **Find the reciprocal of each of the following:**

i. $(3/8)^4$

Solution:-

We know that the reciprocal of $(a/b)^m$ is $(b/a)^m$

Then,

Reciprocal of $(3/8)^4$ is $(8/3)^4$

ii. $(-5/6)^{11}$

Solution:-

We know that the reciprocal of $(a/b)^m$ is $(b/a)^m$

Then,

Reciprocal of $(-5/6)^{11}$ is $(-6/5)^{11}$

iii. $(6)^7$

Solution:-

We know that the reciprocal of $(a/b)^m$ is $(b/a)^m$

Then,

Reciprocal of $(6)^7$ is $(1/6)^7$

iv. $(-4)^3$

Solution:-

We know that the reciprocal of $(a/b)^m$ is $(b/a)^m$

Then,

Reciprocal of $(-4)^3$ is $(-1/4)^3$

6. **Find the value of each of the following:**

i. 8^0

Solution:-

By definition, we have $a^0 = 1$ for every integer.

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$\therefore 8^0 = 1$

ii. **$(-3)^0$**
   Solution:-
   By definition, we have $a^0 = 1$ for every integer.
   $\therefore (-3)^0 = 1$

iii. **$4^0 + 5^0$**
   Solution:-
   By definition, we have $a^0 = 1$ for every integer.
   $\therefore 4^0 + 5^0$
   $= 1 + 1$
   $= 2$

iv. **$6^0 \times 7^0$**
   Solution:-
   By definition, we have $a^0 = 1$ for every integer.
   $\therefore 6^0 \times 7^0$
   $= 1 \times 1$
   $= 1$

7. **Simplify each of the following and express each as a rational number:**
   i. **$(3/2)^4 \times (1/5)^2$**
      Solution:-
      We have,
      $\quad (3^4/2^4) = (3\times3\times3\times3)/ (2\times2\times2\times2) = (81/16)$
      $\quad (1^2/5^2) = (1\times1)/ (5\times5) = (1/25)$
      Then,
      $\quad = (81/16) \times (1/25)$
      $\quad = (81\times1) / (16\times25)$
      $\quad = (81/400)$

   ii. **$(-2/3)^5 \times (-3/7)^3$**
      Solution:-
      We have,
      $\quad (-2^5/3^5) = (-2\times-2\times-2\times-2\times-2)/ (3\times3\times3\times3\times3) = (-32/243)$
      $\quad (-3^3/7^3) = (-3\times-3\times-3)/ (7\times7\times7) = (-27/343)$
      Then,
      $\quad = (-32/243) \times (-27/343)$
      $\quad = (-32\times-27) / (243\times343)$
      By simplifying,
      $\quad = (-32\times-1) / (9/343)$
      $\quad = (32/3087)$

iii. $(-1/2)^5 \times 2^3 \times (3/4)^2$
Solution:-
We have,
   $(-1^5/2^5) = (-1\times-1\times-1\times-1\times-1)/ (2\times2\times2\times2\times2) = (-1/32)$
   $(2)^3 = (2\times2\times2) = 8$
   $(3^2/4^2) = (3\times3)/ (4\times4) = (9/16)$
Then,
   $= (-1/32) \times 8 \times (9/16)$
   $= (-1\times8\times9) / (32\times 1\times16)$
By simplifying,
   $= (-1\times1\times9) / (32\times1\times2)$
   $= (-9/64)$

iv. $(2/3)^2 \times (-3/5)^3 \times (7/2)^2$
Solution:-
We have,
   $(2^2/3^2) = (2\times2)/ (3\times3) = (4/9)$
   $(-3/5)^3 = (-3\times-3\times-3) / (5\times5\times5) = (-27/125)$
   $(7^2/2^2) = (7\times7)/ (2\times2) = (49/4)$
Then,
   $= (4/9) \times (-27/125) \times (49/4)$
   $= (4\times-27\times49) / (9\times 125\times4)$
On simplifying,
   $= (1\times-3\times49) / (1\times125\times1)$
   $= (-147/125)$

v. $\{(-3/4)^3-(-5/2)^3\} \times 4^2$
Solution:-
We have,
   $= \{(-3^3/4^3)-(5^3/2^3)\} \times 16$
   $= \{(-27/64)-(-125/8)\} \times 16$
First we find the difference of $\{(-27/64)-(125/8)\}$
LCM of 64 and 8 is 64
   $= (-27\times1) / (64\times1) = (-27/64)$
   $= (125\times8) / (8 \times8) = (1000/64)$
   $= (1000- (-27))/64$
   $= (1000+27)/64$
   $= (973/64)$
   $= (973/64) \times 16$
   $= (973/4)$

8. **Simplify and express each as a rational number:**
   i. $(4/9)^6 \times (4/9)^{-4}$

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Solution:-
We have,

= $(4/9)^{(6+ (-4))}$ … $[\{(a/b)^m × (a/b)^n\} = (a/b)^{m-n}]$
= $(4/9)^{(6-4)}$
= $(4/9)^2$
= $(4^2/9^2)$
= $(16/81)$

ii.   **(-7/8)$^{-3}$× (-7/8)^2**
Solution:-
We have,

= $(-7/8)^{(-3+ 2)}$ … $[\{(a/b)^m × (a/b)^n\} = (a/b)^{m-n}]$
= $(-7/8)^{(-1)}$
= $(-8/7)$

iii.   **(4/3)$^{-3}$× (4/3)$^{-2}$**
Solution:-
We have,

= $(4/3)^{(-3+ (-2))}$ … $[\{(a/b)^m × (a/b)^n\} = (a/b)^{m-n}]$
= $(4/3)^{(-3-2)}$
= $(4/3)^{-5}$
= $(3/4)^5$
= $(3^5/4^5)$
=243/1024

9.   **Express each of the following as a rational number:**
   i.   **5^{-3}**
   Solution:-
   We know that,

= $(5)^{-3} = (1/5)^3$ … $[\because (a/b)^{-n} = (b/a)^n]$
= $(1^3/5^3)$
= $(1/125)$

   ii.   **(-2)$^{-5}$**
   Solution:-
   We know that,

= $(-2)^{-5} = (-1/2)^3$ … $[\because (a/b)^{-n} = (b/a)^n]$
= $(-1^3/2^3)$
= $(-1/8)$

   iii.   **(1/4)$^{-4}$**
   Solution:-
   We know that,

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$= (1/4)^{-4} = (4/1)^4$ … [∵ $(a/b)^{-n} = (b/a)^n$]
$= (4^4/1^4)$
$= (256/1)$
$= 256$

iv. $(-3/4)^{-3}$
Solution:-
We know that,
     $= (-3/4)^{-3} = (-4/3)^3$ … [∵ $(a/b)^{-n} = (b/a)^n$]
     $= (-4^3/3^3)$
     $= (-64/27)$

v. $(-3)^{-1} \times (1/3)^{-1}$
Solution:-
We know that,
     $= (-3)^{-1} = (-1/3)^1$ … [∵ $(a/b)^{-n} = (b/a)^n$]
     $= (1/3)^{-1} = (3/1)^1$ … [∵ $(a/b)^{-n} = (b/a)^n$]
     $= (-1/3) \times (3/1)$
     $= (-1 \times 3)/ (3 \times 1)$
     $= (-3/3)$
     $= -1$

vi. $(5/7)^{-1} \times (7/4)^{-1}$
Solution:-
We know that,
     $= (5/7)^{-1} = (7/5)^1$ … [∵ $(a/b)^{-n} = (b/a)^n$]
     $= (7/4)^{-1} = (4/7)^1$ … [∵ $(a/b)^{-n} = (b/a)^n$]
     $= (7/5) \times (4/7)$
     $= (7 \times 4)/ (5 \times 7)$
On simplifying,
     $= (1 \times 4)/ (5 \times 1)$
     $= 4/5$

vii. $(5^{-1} - 7^{-1})^{-1}$
Solution:-
We know that,
     $= (5)^{-1} = (1/5)^1$ … [∵ $(a/b)^{-n} = (b/a)^n$]
     $= (7)^{-1} = (1/7)^1$ … [∵ $(a/b)^{-n} = (b/a)^n$]
Now subtract,
     $= \{(1/5) - (1/7)\}^{-1}$
     $= \{(7-5)/35\}^{-1}$ … [LCM of 5 and 7 is 35]
     $= \{2/35\}^{-1}$
     $= \{35/2\}$

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viii. $\{(4/3)^{-1} - (1/4)^{-1}\}^{-1}$

Solution:-

We know that,

$= (4/3)^{-1} = (3/4)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

$= (1/4)^{-1} = (4/1)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

Now subtract,

$= \{(3/4) - (4/1)\}^{-1}$

$= \{(3-16)/4\}^{-1}$ ... [LCM of 4 and 1 is 4]

$= \{-13/4\}^{-1}$

$= \{-4/13\}$

ix. $\{(3/2)^{-1} \div (-2/5)^{-1}\}$

Solution:-

We know that,

$= (3/2)^{-1} = (2/3)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

$= (-2/5)^{-1} = (-5/2)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

Now divide,

$= \{(2/3) \div (-5/2)\}^-$

$= \{(2/3) \times (-2/5\}$

$= \{(2 \times -2) / (3 \times 5)$

$= \{-4/15\}$

x. $(23/25)^0$

Solution:-

$= (23/25)^0 = 1$

Because, by definition, we have $a^0 = 1$ for every integer.

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EXERCISE 5B   **PAGE: 92**

1. **Express each of the following numbers in standard form:**

   i. **538**
      Solution:-
      A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
      Then,
      $538 = 5.38 \times 10^2$

   ii. **6428000**
      Solution:-
      A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
      Then,
      $6428000 = 6.428 \times 10^6$

   iii. **82934000000**
      Solution:-
      A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
      Then,
      $82934000000 = 8.2934 \times 10^{10}$

   iv. **940000000000**
      Solution:-
      A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
      Then,
      $940000000000 = 9.4 \times 10^{11}$

   v. **23000000**
      Solution:-
      A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
      Then,
      $23000000 = 2.3 \times 10^7$

2. **Express each of the following numbers in standard form:**

   i. **Diameter of Earth = 12756000 m**
      Solution:-
      A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.

Then,
Diameter of Earth = 12756000 m
$$= (1.2156 \times 10^7) \text{ m} \qquad \text{(in standard form)}$$

ii. Distance between Earth and Moon = 384000000 m
Solution:-

A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
Then,
Distance between Earth and Moon = 384000000 m
$$= (3.84 \times 10^8) \text{ m} \qquad \text{(in standard form)}$$

iii. Population of India in March 2001= 1027000000
Solution:-

A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
Then,
Population of India in March 2001= 1027000000
$$= (1.027 \times 10^9) \qquad \text{(in standard form)}$$

iv. Number of stars in a galaxy = 100000000000
Solution:-

A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
Then,
Number of stars in a galaxy = 100000000000
$$= (1 \times 10^{11}) \qquad \text{(in standard form)}$$

v. The present age of universe = 12000000000 years
Solution:-

A given number is said to be in standard form if it can be expressed as $k \times 10^n$, where k is a real number such that $1 \le k < 10$ and n is a positive integer.
Then,
The present age of universe = 12000000000
$$= (1.2 \times 10^{10}) \text{ years} \qquad \text{(in standard form)}$$

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EXERCISE 5C **PAGE: 93**

Mark tick against the correct answer in each of the following:

1. $(6^{-1} - 8^{-1})^{-1}$ =?

(a) (-1/2)   (b)-2   (c) (1/24)   (d) 24

Solution:-

(D) 24

We know that,

= $(6)^{-1}$ = $(1/6)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

= $(8)^{-1}$ = $(1/8)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

Now subtract,

= $\{(1/6) - (1/8)\}^{-1}$

= $\{(4-3)/24\}^{-1}$ ... [LCM of 6 and 8 is 24]

= $\{1/24\}^{-1}$

= $\{24/1\}$

= 24

2. $(5^{-1} \times 3^{-1})^{-1}$

(a)(1/15)   (b)(-1/15)   (c) 15   (d)-15

Solution:-

(c) 15

We know that,

= $(5)^{-1}$ = $(1/5)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

= $(3)^{-1}$ = $(1/3)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

Now multiply,

= $\{(1/5) \times (1/3)\}^{-1}$

= $\{(1×1)/(5×3)\}^{-1}$

= $\{1/15\}^{-1}$

= $\{15/1\}$

= 15

3. $(2^{-1} - 4^{-1})^2$

(a) 4   (b)-4   (c) (1/16)   (d) (-1/16)

Solution:-

(c) (1/16)

We know that,

= $(2)^{-1}$ = $(1/2)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

= $(4)^{-1}$ = $(1/4)^1$ ... [∵ $(a/b)^{-n} = (b/a)^n$]

Now subtract,

= $\{(1/2) - (1/4)\}^2$

= $\{(2-1)/4\}^2$ ... [LCM of 2 and 4 is 4]

= $\{1/4\}^2$

= $\{1^2/4^2\}$

$= \{1/16\}$

4. $(1/2)^{-2} + (1/3)^{-2} + (1/4)^{-2} =?$
   (a)$(61/144)$ (b) 29   (c) $(144/61)$ (d) none of these
   Solution:-
   (b) 29
           We know that,
               $= (1/2)^{-2}= (2/1)^2$ ... $[\because (a/b)^{-n} = (b/a)^n]$
               $= (1/3)^{-2} = (3/1)^2$ ... $[\because (a/b)^{-n} = (b/a)^n]$
               $= (1/4)^{-2} = (4/1)^2$ ... $[\because (a/b)^{-n} = (b/a)^n]$
           Now add,
               $= (2)^2+ (3)^2+ (4)^2$
               $= 4 + 9 + 16$
               $= 29$

5. $\{6^{-1}+(3/2)^{-1}\}^{-1}$
   (a)$(2/3)$ (b)$(5/6)$ (c)$(6/5)$ (d) None of these
   Solution:-
   (c)$(6/5)$
           We know that,
               $= (6)^{-1}= (1/6)$ ... $[\because (a/b)^{-n} = (b/a)^n]$
               $= (3/2)^{-1} = (2/3)$ ... $[\because (a/b)^{-n} = (b/a)^n]$
           Now add,
               $= \{(1/6) + (2/3)\}^{-1}$
               $= \{(1+4)/ 6\}^{-1}$ ... [LCM of 6 and 3 is 6]
               $= \{5/6\}^{-1}$
               $= \{6/5\}$

6. $(-1/2)^{-6} =?$
   (a)-64 (b) 64   (c) $(1/64)$ (d) $(-1/64)$
   Solution:-
   (b) 64
           We know that,
               $= (-1/2)^{-6}= (-2/1)^6$ ... $[\because (a/b)^{-n} = (b/a)^n]$
               $= (-2)^6$
               $= 64$

7. $\{(3/4)^{-1} – (1/4)^{-1}\}^{-1}=?$
   (a)$(3/8)$ (b)$(-3/8)$ (c)$(8/3)$ (d)$(-8/3)$
   Solution:-
   (b)$(-3/8)$
           We know that,
               $= (3/4)^{-1}= (4/3)^1$ ... $[\because (a/b)^{-n} = (b/a)^n]$

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$= (1/4)^{-1} = (4/1)^{1}$ … [$\because (a/b)^{-n} = (b/a)^{n}$]

Now subtract,

$= \{(4/3) - (4/1)\}^{-1}$

$= \{(4-12)/3\}^{-1}$ … [LCM of 3 and 1 is 3]

$= \{-8/3\}^{-1}$

$= \{-3/8\}$

8. $[\{(-1/2)^{2}\}^{-2}]^{-1} = ?$

  (a) $(1/16)$ (b)16   (c)$(-1/16)$ (d)-16

    Solution:-

$[\{(-1/2)^{2}\}^{-2}]^{-1} = [\{(-1^{2}/2^{2})\}^{-2}]^{-1}$

$= [\{1/4\}^{-2}]^{-1}$

$= [\{4\}^{2}]^{-1}$

$= [16]^{-1}$

$= [1/16]$

9. $(5/6)^{0} = ?$

  (a) 5/6   (b) 0   (c)1   (d)none of these

  Solution:-

$(5/6)^{0} = 1$

By definition, we have $a^{0} = 1$ for every integer.

10. $(2/3)^{-5} = ?$

  (a)$(32/243)$ (b)$(243/32)$ (c)$(-32/243)$ (d)$(-243/32)$

  Solution:-

$(2/3)^{-5} = (3/2)^{5}$

$= (3^{5}/2^{5})$

$= (243/32)$