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1. Using laws of exponents, simplify and write the answer in exponential form:

(i) $3^2 \times 3^4 \times 3^8$

Solution:-

By the rule of multiplying the powers with the same base = $a^m \times a^n = a^{m+n}$

Then,

= $(3)^{2+4+8}$

= 3^{14}

(ii) $6^{15} \div 6^{10}$

Solution:-

By the rule of dividing the powers with the same base = $a^m \div a^n = a^{m-n}$

Then,

= $(6)^{15-10}$

= 6^5

(iii) $a^3 \times a^2$

Solution:-

By the rule of multiplying the powers with the same base = $a^m \times a^n = a^{m+n}$

Then,

= $(a)^{3+2}$

= a^5

(iv) $7^x \times 7^2$

Solution:-

By the rule of multiplying the powers with the same base = $a^m \times a^n = a^{m+n}$

Then,

$= (7)^{x+2}$

(v) $(5^2)^3 \div 5^3$

Solution:-

By the rule of taking the power of as power = $(a^m)^n = a^{mn}$

$(5^2)^3$ can be written as = $(5)^{2 \times 3}$

$= 5^6$

Now, $5^6 \div 5^3$

By the rule of dividing the powers with the same base = $a^m \div a^n = a^{m-n}$

Then,

$= (5)^{6-3}$

$= 5^3$

(vi) $2^5 \times 5^5$

Solution:-

By the rule of multiplying the powers with the same exponents = $a^m \times b^m = ab^m$

Then,

$= (2 \times 5)^5$

$= 10^5$

(vii) $a^4 \times b^4$

Solution:-

By the rule of multiplying the powers with the same exponents = $a^m \times b^m = ab^m$

Then,

$= (a \times b)^4$

$= ab^4$

(viii) $(3^4)^3$

Solution:-

By the rule of taking the power of as power = $(a^m)^n = a^{mn}$

$(3^4)^3$ can be written as = $(3)^{4 \times 3}$

= 3^{12}

(ix) $(2^{20} \div 2^{15}) \times 2^3$

Solution:-

By the rule of dividing the powers with the same base = $a^m \div a^n = a^{m-n}$

$(2^{20} \div 2^{15})$ can be simplified as,

= $(2)^{20-15}$

= 2^5

Then,

By the rule of multiplying the powers with the same base = $a^m \times a^n = a^{m+n}$

$2^5 \times 2^3$ can be simplified as,

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

= 2^8

(x) $8^t \div 8^2$

Solution:-

By the rule of dividing the powers with the same base = $a^m \div a^n = a^{m-n}$

Then,

= $(8)^{t-2}$

2. Simplify and express each of the following in exponential form:

(i) $(2^3 \times 3^4 \times 4)/ (3 \times 32)$

Solution:-

Factors of 32 = 2 × 2 × 2 × 2 × 2

= 2^5

Factors of 4 = 2 × 2

$= 2^2$

Then,

$= (2^3 \times 3^4 \times 2^2)/ (3 \times 2^5)$

$= (2^{3+2} \times 3^4) / (3 \times 2^5)$ … [$\because a^m \times a^n = a^{m+n}$]

$= (2^5 \times 3^4) / (3 \times 2^5)$

$= 2^{5-5} \times 3^{4-1}$ … [$\because a^m \div a^n = a^{m-n}$]

$= 2^0 \times 3^3$

$= 1 \times 3^3$

$= 3^3$

(ii) $((5^2)^3 \times 5^4) \div 5^7$

Solution:-

$(5^2)^3$ can be written as $= (5)^{2\times 3}$ … [$\because (a^m)^n = a^{mn}$]

$= 5^6$

Then,

$= (5^6 \times 5^4) \div 5^7$

$= (5^{6+4}) \div 5^7$ … [$\because a^m \times a^n = a^{m+n}$]

$= 5^{10} \div 5^7$

$= 5^{10-7}$ … [$\because a^m \div a^n = a^{m-n}$]

$= 5^3$

(iii) $25^4 \div 5^3$

Solution:-

$(25)^4$ can be written as $= (5 \times 5)^4$

$= (5^2)^4$

$(5^2)^4$ can be written as $= (5)^{2\times 4}$ … [$\because (a^m)^n = a^{mn}$]

$= 5^8$

Then,

$= 5^8 \div 5^3$

$= 5^{8-3}$ … [$\because a^m \div a^n = a^{m-n}$]

$= 5^5$

(iv) $(3 \times 7^2 \times 11^8)/ (21 \times 11^3)$

Solution:-

Factors of 21 = 7 × 3

Then,

$= (3 \times 7^2 \times 11^8)/ (7 \times 3 \times 11^3)$

$= 3^{1-1} \times 7^{2-1} \times 11^{8-3}$

$= 3^0 \times 7 \times 11^5$

$= 1 \times 7 \times 11^5$

$= 7 \times 11^5$

(v) $3^7/ (3^4 \times 3^3)$

Solution:-

$= 3^7/ (3^{4+3})$ … [$\because a^m \times a^n = a^{m+n}$]

$= 3^7/ 3^7$

$= 3^{7-7}$ … [$\because a^m \div a^n = a^{m-n}$]

$= 3^0$

$= 1$

(vi) $2^0 + 3^0 + 4^0$

Solution:-

$= 1 + 1 + 1$

$= 3$

(vii) $2^0 \times 3^0 \times 4^0$

Solution:-

$= 1 \times 1 \times 1$

= 1

(viii) $(3^0 + 2^0) \times 5^0$

Solution:-

= (1 + 1) × 1

= (2) × 1

= 2

(ix) $(2^8 \times a^5)/ (4^3 \times a^3)$

Solution:-

$(4)^3$ can be written as = $(2 \times 2)^3$

= $(2^2)^3$

$(2^2)^3$ can be written as = $(2)^{2 \times 3}$ … [∵$(a^m)^n = a^{mn}$]

= 2^6

Then,

= $(2^8 \times a^5)/ (2^6 \times a^3)$

= $2^{8-6} \times a^{5-3}$ … [∵$a^m \div a^n = a^{m-n}$]

= $2^2 \times a^2$ … [∵$(a^m)^n = a^{mn}$]

= $2a^2$

(x) $(a^5/a^3) \times a^8$

Solution:-

= $(a^{5-3}) \times a^8$ … [∵$a^m \div a^n = a^{m-n}$]

= $a^2 \times a^8$

= a^{2+8} … [∵$a^m \times a^n = a^{m+n}$]

= a^{10}

(xi) $(4^5 \times a^8b^3)/ (4^5 \times a^5b^2)$

Solution:-

= $4^{5-5} \times (a^{8-5} \times b^{3-2})$ … [∵$a^m \div a^n = a^{m-n}$]

$= 4^0 \times (a^3b)$

$= 1 \times a^3b$

$= a^3b$

(xii) $(2^3 \times 2)^2$

Solution:-

$= (2^{3+1})^2$ … [$\because a^m \times a^n = a^{m+n}$]

$= (2^4)^2$

$(2^4)^2$ can be written as $= (2)^{4 \times 2}$ … [$\because (a^m)^n = a^{mn}$]

$= 2^8$

3. Say true or false and justify your answer:

(i) $10 \times 10^{11} = 100^{11}$

Solution:-

Let us consider Left Hand Side (LHS) $= 10 \times 10^{11}$

$= 10^{1+11}$ … [$\because a^m \times a^n = a^{m+n}$]

$= 10^{12}$

Now, consider Right Hand Side (RHS) $= 100^{11}$

$= (10 \times 10)^{11}$

$= (10^{1+1})^{11}$

$= (10^2)^{11}$

$= (10)^{2 \times 11}$ … [$\because (a^m)^n = a^{mn}$]

$= 10^{22}$

By comparing LHS and RHS,

LHS ≠ RHS

Hence, the given statement is false.

(ii) $2^3 > 5^2$

Solution:-

Let us consider LHS = 2^3

Expansion of $2^3 = 2 \times 2 \times 2$

= 8

Now, consider RHS = 5^2

Expansion of $5^2 = 5 \times 5$

= 25

By comparing LHS and RHS,

LHS < RHS

$2^3 < 5^2$

Hence, the given statement is false.

(iii) $2^3 \times 3^2 = 6^5$

Solution:-

Let us consider LHS = $2^3 \times 3^2$

Expansion of $2^3 \times 3^2 = 2 \times 2 \times 2 \times 3 \times 3$

= 72

Now, consider RHS = 6^5

Expansion of $6^5 = 6 \times 6 \times 6 \times 6 \times 6$

= 7776

By comparing LHS and RHS,

$72 \neq 7776$

LHS ≠ RHS

Hence, the given statement is false.

(iv) $3^0 = (1000)^0$

Solution:-

Let us consider LHS = 3^0

= 1

Now, consider RHS = 1000^0

= 1

By comparing LHS and RHS,

LHS = RHS

$3^0 = 1000^0$

Hence, the given statement is true.

4. Express each of the following as a product of prime factors only in exponential form:

(i) 108 × 192

Solution:-

The factors of 108 = 2 × 2 × 3 × 3 × 3

= $2^2 \times 3^3$

The factors of 192 = 2 × 2 × 2 × 2 × 2 × 2 × 3

= $2^6 \times 3$

Then,

= $(2^2 \times 3^3) \times (2^6 \times 3)$

= $2^{2+6} \times 3^{3+1}$ … [$\because a^m \times a^n = a^{m+n}$]

= $2^8 \times 3^4$

(ii) 270

Solution:-

The factors of 270 = 2 × 3 × 3 × 3 × 5

= $2 \times 3^3 \times 5$

(iii) 729 × 64

The factors of 729 = 3 × 3 × 3 × 3 × 3 × 3

= 3^6

The factors of 64 = 2 × 2 × 2 × 2 × 2 × 2

= 2^6

Then,

= $(3^6 \times 2^6)$

= $3^6 \times 2^6$

(iv) 768

Solution:-

The factors of 768 = 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 × 3

= $2^8 \times 3$

5. Simplify:

(i) $((2^5)^2 \times 7^3)/ (8^3 \times 7)$

Solution:-

8^3 can be written as = $(2 \times 2 \times 2)^3$

= $(2^3)^3$

We have,

= $((2^5)^2 \times 7^3)/ ((2^3)^3 \times 7)$

= $(2^{5 \times 2} \times 7^3)/ ((2^{3 \times 3} \times 7)$ … [$\because (a^m)^n = a^{mn}$]

= $(2^{10} \times 7^3)/ (2^9 \times 7)$

= $(2^{10-9} \times 7^{3-1})$ … [$\because a^m \div a^n = a^{m-n}$]

= 2×7^2

= 2 × 7 × 7

= 98

(ii) $(25 \times 5^2 \times t^8)/ (10^3 \times t^4)$

Solution:-

25 can be written as = 5 × 5

= 5^2

10^3 can be written as = 10^3

= $(5 \times 2)^3$

$= 5^3 \times 2^3$

We have,

$= (5^2 \times 5^2 \times t^8)/ (5^3 \times 2^3 \times t^4)$

$= (5^{2+2} \times t^8)/ (5^3 \times 2^3 \times t^4)$ … [$\because a^m \times a^n = a^{m+n}$]

$= (5^4 \times t^8)/ (5^3 \times 2^3 \times t^4)$

$= (5^{4-3} \times t^{8-4})/ 2^3$ … [$\because a^m \div a^n = a^{m-n}$]

$= (5 \times t^4)/ (2 \times 2 \times 2)$

$= (5t^4)/ 8$

(iii) $(3^5 \times 10^5 \times 25)/ (5^7 \times 6^5)$

Solution:-

10^5 can be written as $= (5 \times 2)^5$

$= 5^5 \times 2^5$

25 can be written as $= 5 \times 5$

$= 5^2$

6^5 can be written as $= (2 \times 3)^5$

$= 2^5 \times 3^5$

Then we have,

$= (3^5 \times 5^5 \times 2^5 \times 5^2)/ (5^7 \times 2^5 \times 3^5)$

$= (3^5 \times 5^{5+2} \times 2^5)/ (5^7 \times 2^5 \times 3^5)$ … [$\because a^m \times a^n = a^{m+n}$]

$= (3^5 \times 5^7 \times 2^5)/ (5^7 \times 2^5 \times 3^5)$

$= (3^{5-5} \times 5^{7-7} \times 2^{5-5})$

$= (3^0 \times 5^0 \times 2^0)$ … [$\because a^m \div a^n = a^{m-n}$]

$= 1 \times 1 \times 1$

$= 1$