(k) $\left(2\frac{1}{4}\right)^{\frac{1}{2}} \times \left(\frac{2}{3}\right)^{-1} + \left(\frac{2}{5}\right)^{0}$ (l) $\left(\frac{15}{8} - \left(\frac{3}{5}\right)^{-1}\right) \times \left(\frac{5}{2}\right)^{-3}$

(m) $\frac{9^{-1}}{5} + \left(\frac{2}{3}\right)^{-2} \times \left(\frac{9}{4}\right)^{-2}$ (n) $\left(\frac{5}{6}\right)^{3} \times \left(\frac{25}{36}\right)^{-2} \div \left(\frac{15}{16}\right)^{-1}$

(o) $5^{\frac{1}{2}} \times 5^{\frac{3}{2}} + \left(7^{\frac{1}{2}}\right)^{5} \div 7^{\frac{1}{2}}$

4. Express the following as a single index number with the smallest possible base.

(a) 27×81 (b) $\frac{128}{32}$

(c) $\frac{16}{81} \div 625$ (d) $(81^2)^{-4}$

(e) $\frac{4^8}{8^4}$ (f) $\frac{125^4}{49^6}$

(g) $\left(\frac{81}{36}\right)^3$ (h) $\frac{(16^2)^3}{(8^3)^2}$

(i) $4(2^5)^3$ (j) $\frac{2^{n+3} \times 2^{2n}}{8^{n+1}}$

5. Given that $a = 2$, $b = -2$ and $c = -\frac{1}{2}$, calculate the following.

(a) a^b (b) b^a

(c) bc^a (d) $(ac)^b$

(e) c^{a+b} (f) $a^a(b^a - c^a)$

(g) $\frac{a^2 + b^2 + c^2}{a^2 - b^2 - c^2}$ (h) $a^3 + 3a + 3^a$

6. Solve for x and y if

(a) $(10^4)^y = \frac{1}{10^4} = 10^x$, (b) $(2^y)^3 = 2x^3 = 16$.

7. Simplify the following and express your answers in positive index form.

(a) $\frac{a^7}{a^{-2}} \times \frac{a^3}{a^4} \div \frac{a^5}{a^2}$ (b) $\frac{(a^3 \times a^2)^5}{a^9 \times a^{10}}$

(c) $\frac{5a^7 \times 4(a \times a^3)^4}{(a^{-3} \times a^2)^5}$ (d) $\frac{(a^{-3} \times a^2)^{-4}}{a^2 \times a^3} \div \frac{2a^{-4} \times a^5}{a^2 \times a^{-6}}$

(e) $4a^3 \times 3a^{-4} \div 9a^{-6}$ (f) $\frac{32a^6b^4}{6a^2b \times (4ab)^2}$

(g) $\frac{10(pq)^3}{(2q)^3p^5} \div \frac{45p}{(6q)^2}$ (h) $(3p^4 \times p^0 \times p^{-5})^3$

(i) $\frac{m}{5} \times \left(\frac{5}{m^2}\right)^2$ (j) $8(x^{-2}y^3)^4 \times (2xy^2)^{-2}$

(k) $\frac{(2ab^{-2})^3}{4a^5b^3}$ (l) $(a^3 \times a^{-2})^5 \div a^{-5} \div a^{-7}$

(m) $(a^{-2})^0 \div a^{-3} \div a^5 \times a^7 + a^5$ (n) $2a^2 \times 3a^2 \times 4a^2$

(o) $2a^2 + 3a^2 + 4a^2$ (p) $(a^3b^2)^3 \div (a^2b^0)^{-2}$

(q) $(3s^2)^2 \times \left(\frac{s^2}{3t}\right)^{-3}$ (r) $\frac{(-3a)^4 \times a}{9a^3}$

(s) $\frac{(-2a^3)^3}{(2a^{-2})^{-3}}$ (t) $\frac{(x^2y^3)^{-2} \times (}{(-x^5y^7)}$

(u) $\frac{9x^3y^4z}{15x^7yz^3} \div \frac{6xy^7z^4}{(5xyz^3)^2}$ (v) $\frac{2a^{-7}b^2}{b^{-4}c^{-2}} \times$

(w) $\frac{(2^3x^2y^4)(5x^3y^2)^{-2}}{(10x^{-2}y^{-3})^{-2}}$ (x) $\frac{4x^{-1}y}{(x^2y)(2x^{-3}y)}$

(y) $\frac{9m^2u}{6n^3u^2} \div \frac{24m}{15nu^2} \times \frac{8n^2}{10m^3u}$ (z) $\frac{2a^{n+2}}{b^n} \div$

8. Simplify the following.

(a) $(-x^4)^3$ (b) $-3(x^2)^4$

(c) $\frac{(a^4)^6}{-a^3 \times (-a^2)^9}$ (d) $(2a^{-1})^4$

(e) $\frac{(-p^4)^5}{-(p^5)^4}$ (f) $\frac{(-x^3)^{-6} \times (y^3)}{(x^{-9})^2 \times y^{-8}}$

(g) $\frac{(ab)^{-4}(abc)^5}{(2ab^2)^2(3abc^2)^{-3}}$ (h) $x^{-4} \div x^{-7}$

(i) $(a^2 \times a^{-5})^{-3}$ (j) $(pqr)^{-2} \times$

(k) $\frac{(8a^5b^4)(3a^2b^5)^3}{(9ab^2)(2ab)^3}$ (l) $\frac{(ab^2)^3}{(a^2b)^4} \times \frac{(a}{(b}$

(m) $\frac{(p^2q^{-3})^4}{(q^4r^3)^2} \times \frac{(q^{-2}r^5)^6}{(p^{-3}r^4)^3}$ (n) $\frac{a^2b^{-5}}{c^3} \times \frac{(a^{-}}{(ac}$

(o) $\frac{(12p^3q^3)^2}{3pq^{10}} \times \frac{(3q^2)^2}{24p^5}$

9. Find the value of x in each of the following.

(a) $4^x = \frac{1}{64}$ (b) $3^{-x} = 81$

(c) $8^{-x} = \frac{1}{2}$ (d) $125^x = \frac{1}{5}$

(e) $2^x \div 2^3 = 32$ (f) $5^4 \times 125 = 5$

(g) $8^x = 128^3$ (h) $9^x \times 3^3 = 27$

(i) $27^x = 9^{x-1}$ (j) $2(9^x) = 54$

(k) $9^{x-2} = 81^{7-x}$ (l) $(3x)^{-2} = 9$

(m) $3x^{-4} = \frac{1}{27}$ (n) $49^{3x} \times 7^{2x-5} =$

(o) $\left(\frac{3}{2}\right)^x \times \left(\frac{4}{9}\right)^{-x} = 3\frac{3}{8}$

10. Solve the following equations.

(a) $4x^2 = 1.44 \times 10^{-4}$ (b) $\frac{4}{5}x^3 = 21\frac{3}{5}$