

Qn 4 a)

$$\frac{a^3 b^2}{5a^4 b^7} \times \frac{2a^6 b}{a^9 b^3}$$

$$= \frac{2 \times a^3 \times a^6 \times b^2 \times b}{5 \times a^4 \times a^9 \times b^7 \times b^3}$$

$$= \frac{2 \times a^{3+6} \times b^{2+1}}{5 \times a^{4+9} \times b^{7+3}}$$

$$= \frac{2 \times a^9 \times b^3}{5 \times a^{13} \times b^{10}}$$

$$= \frac{2}{5} \times a^{9-13} \times b^{3-10}$$

$$= \frac{2}{5} \times a^{-4} \times b^{-7}$$

$$= \frac{2}{5} \times \frac{1}{a^4} \times \frac{1}{b^7}$$

$$= \frac{2}{5a^4 b^7}$$

Multiply fractions.  
and collect like terms.

Multiply  $a^m \times a^n = a^{m+n}$   
• in numerator  
• in denominator

simplify powers

Divide  $\frac{a^m}{a^n} = a^{m-n}$

Simplify powers.

write with positive powers.

Qn 4 b)

$$\frac{(2a^6)^2 \times 4ab^6}{10a^7b^3 \times 6a^3}$$

Brackets simplified  
Indices:  $(a^m)^n = a^{mn}$

$$= \frac{2^2 a^{12} \times 4ab^6}{10a^7b^3 \times 6a^3}$$

Multiply fractions and collect like terms

$$= \frac{2^2 \times 4 \times a^{12} \times a \times b^6}{10 \times 6 \times a^7 \times a^3 \times b^3}$$

Multiply terms  
 $a^m \times a^n = a^{m+n}$

$$= \frac{16}{60} \times \frac{a^{12+1}}{a^{7+3}} \times \frac{b^6}{b^3}$$

Simplify powers

$$= \frac{8}{30} \times \frac{a^{13}}{a^{10}} \times \frac{b^6}{b^3}$$

Divide terms  $\frac{a^m}{a^n} = a^{m-n}$

$$= \frac{4}{15} \times a^{13-10} \times b^{6-3}$$

Simplify powers

$$= \frac{4}{15} \times a^3 \times b^3$$

$$= \frac{4a^3b^3}{15}$$



Qn 4 c)

$$\frac{(m^4 n^3)^2}{(m^6 n^4)^4} \times \frac{(m^3 n^3)^3}{(2mn)^2}$$
$$= \frac{m^8 n^6}{m^{24} n^4} \times \frac{m^9 n^9}{2^2 m^2 n^2}$$

$$= \frac{m^8 \times m^9 \times n^6 \times n^9}{2^2 \times m^{24} \times m^2 \times n^4 \times n^2}$$

$$= \frac{m^{8+9} \times n^{6+9}}{2^2 \times m^{24+2} \times n^{4+2}}$$

$$= \frac{m^{17} \times n^{15}}{4 \times m^{26} \times n^6}$$

$$= \frac{1}{4} \times m^{17-26} \times n^{15-6}$$

$$= \frac{1}{4} \times m^{-9} \times n^9$$

$$= \frac{1}{4} \times \frac{1}{m^9} \times n^9$$

$$= \frac{n^9}{4m^9}$$

Brackets simplified

Index:  $(a^m)^n = a^{mn}$

Multiply fractions and collect like terms

Multiply  $a^m \times a^n = a^{m+n}$   
• in numerator  
• in denominator

Simplify powers

Divide terms

Simplify powers

Write with positive powers

Qn 4d)

$$\left(\frac{2m^3n^2}{3mn^5}\right)^3 \times \frac{6m^2n^4}{4m^3n^{10}}$$

Bracket needs simplifying  
using  $\frac{a^m}{a^n} = a^{m-n}$

$$= \left(\frac{2}{3} \times m^{3-1} \times n^{2-5}\right)^3 \times \frac{6m^2n^4}{4m^3n^{10}}$$

Simplify powers.

$$= \left(\frac{2}{3} \times m^2 \times n^{-3}\right)^3 \times \frac{6m^2n^4}{4m^3n^{10}}$$

Indices and:  $(a^m)^n = a^{m \times n}$   
 $\frac{a^m}{a^n} = a^{m-n}$

$$= \frac{2^3}{3^3} \times m^6 \times n^{-9} \times \frac{6}{4} \times m^{2 \times 3} \times n^{4 \times 3}$$

Collect like terms.

$$= \frac{2^3}{3^3} \times \frac{6}{4} \times m^6 \times m^{-9} \times n^{-9} \times n^{-6}$$

Multiply terms  
 $a^m \times a^n = a^{m+n}$

$$= \frac{8^2 \times 6}{27 \times 4} \times m^{6+(-9)} \times n^{-9+(-6)}$$

Simplify powers.

$$= \frac{12}{27} \times m^5 \times n^{-15}$$

Write with positive powers.

$$\frac{4 \times 3}{9 \times 3} = \frac{12}{27}$$

$$= \frac{4}{9} \times m^5 \times \frac{1}{n^{15}}$$

$$= \frac{4m^5}{9n^{15}}$$



Qn 4e)

$$\left(\frac{2xy^2}{3x^3y^5}\right)^4 \times \left(\frac{x^3y^9}{2y^{10}}\right)^2$$

$$= \frac{2^4 x^4 y^8}{3^4 x^{12} y^{20}} \times \frac{x^6 y^{18}}{2^2 y^{20}}$$

$$= \frac{2^4 \times x^{4+6} \times y^{8+18}}{3^4 \times x^{12} \times y^{20+20}}$$

$$= \frac{2^4 \times x^{10} \times y^{26}}{3^4 \times 2^2 \times x^{12} \times y^{40}}$$

$$= \frac{1}{3^4} \times 2^{4-2} \times x^{10-12} \times y^{26-40}$$

$$= \frac{1}{3^4} \times 2^2 \times x^{-2} \times y^{-14}$$

$$= \frac{4}{81} \times \frac{1}{x^2} \times \frac{1}{y^{14}}$$

$$= \frac{4}{81x^2y^{14}}$$

Can simplify brackets first or do indices first.

Multiply  $a^m \times a^n = a^{m+n}$

Simplify powers

Divide terms  $\frac{a^m}{a^n} = a^{m-n}$

Simplify powers

Write with positive powers

Qn 4 f).

$$\frac{4x^{-5}y^{-3}}{(x^2y^2)^{-2}} \times \frac{3x^5y^6}{2^{-2}x^{-7}y}$$

Bracket simplified.

Indices  $(a^m)^n = a^{mn}$

$$= \frac{4x^{-5}y^{-3}}{x^{-4}y^{-4}} \times \frac{3x^5y^6}{2^{-2}x^{-7}y}$$

Multiply fractions and collect like terms.

$$= \frac{4 \times 3 \times x^{-5} \times x^5 \times y^{-3} \times y^6}{2^{-2} \times x^{-4} \times x^{-7} \times y^{-4} \times y}$$

Multiply terms  $a^m \times a^n = a^{m+n}$

$$= 4 \times 3 \times \frac{1}{2^2} \times \frac{x^{-5+5}}{x^{-4+(-7)}} \times \frac{y^{-3+6}}{y^{-4+1}}$$

Simplify powers

$$= 4 \times 3 \times (2^{-2})^{-1} \times \frac{x^0}{x^{-11}} \times \frac{y^3}{y^{-3}}$$

Divide terms  $\frac{a^m}{a^n} = a^{m-n}$

$$= 12 \times 2^2 \times \frac{x^{0-(-11)}}{1} \times y^{3-(-3)}$$

$$= 48 \times x^{11} \times y^6$$



Qn 4 g)

$$\frac{5p^6q^{-5}}{3q^{-4}} \times \left( \frac{5p^6q^4}{3p^5} \right)^{-2}$$

$$= \frac{5}{3} \times p^6 \times q^{-5-(-4)} \times \left( \frac{5}{3} \times p^{6-5} \times q^4 \right)^{-2}$$

Brackets  
need  
simplifying

$$= \frac{5}{3} \times p^6 \times q^{-1} \times \left( \frac{5}{3} \right)^{-2} \times p^{1 \times -2} \times q^{-8}$$

$$= \frac{5}{3} \times p^6 \times q^{-1} \times \frac{1}{\left( \frac{5}{3} \right)^2} \times p^{-2} \times q^{-8}$$

$$= \frac{5}{3} \times \frac{1}{\left( \frac{5}{3} \right)^2} \times p^{6+(-2)} \times q^{-1+(-8)}$$

$$= \frac{5}{3} \times 1 \div \frac{5^2}{3^2} \times p^4 \times q^{-9}$$

$$= \frac{5}{3} \times 1 \times \frac{3^2}{5^2} \times p^4 \times \frac{1}{q^9}$$

$$= \frac{3}{5} \times p^4 \times \frac{1}{q^9}$$

$$= \frac{3p^4}{5q^9}$$

\* Note: could also do as...

$$\left( \frac{5}{3} \right) \times \left( \frac{5}{3} \right)^{-2} = \left( \frac{5}{3} \right)^{1+(-2)}$$

$$= \left( \frac{5}{3} \right)^{-1}$$

$$= \frac{1}{\left( \frac{5}{3} \right)}$$

$$= 1 \div \frac{5}{3}$$

$$= 1 \times \frac{3}{5}$$

Qn 4b)  $\frac{2a^{\frac{1}{2}}b^{\frac{1}{3}}}{6a^{\frac{1}{3}}b^{\frac{1}{2}}} \times \frac{(4a^{\frac{1}{4}}b)^{\frac{1}{2}}}{b^{\frac{1}{4}}a}$  (a<sup>m</sup>)<sup>n</sup> and  $\frac{a^m}{a^n}$ .

$$= \frac{1}{3} \times a^{\frac{1}{2}-\frac{1}{3}} \times b^{\frac{1}{3}-\frac{1}{2}} \times \frac{4a^{\frac{1}{4} \times \frac{1}{2}} b^{\frac{1}{2}}}{b^{\frac{1}{4}} a^1}$$

$$= \frac{1}{3} \times a^{\frac{3}{6}-\frac{2}{6}} \times b^{\frac{2}{6}-\frac{3}{6}} \times \frac{(2^2)^{\frac{1}{2}} \times a^{\frac{1}{8}-1}}{b^{\frac{1}{4}}}$$

$$= \frac{1}{3} \times a^{\frac{1}{6}} \times b^{-\frac{1}{6}} \times 2 \times a^{-\frac{7}{8}} \times b^{\frac{1}{4}}$$

$$= \frac{1}{3} \times 2 \times a^{\frac{1}{6} + (-\frac{7}{8})} \times b^{-\frac{1}{6} + \frac{1}{4}}$$

$$= \frac{2}{3} \times a^{\frac{4}{24} - \frac{21}{24}} \times b^{-\frac{2}{12} + \frac{3}{12}}$$

$$= \frac{2}{3} \times a^{-\frac{17}{24}} \times b^{\frac{1}{12}}$$

$$= \frac{2}{3} \times \frac{1}{a^{\frac{17}{24}}} \times b^{\frac{1}{12}}$$

$$= \frac{2b^{\frac{1}{12}}}{3a^{\frac{17}{24}}}$$



Qn 4 i)

$$\frac{3x^{\frac{2}{3}}y^{\frac{1}{5}}}{9x^{\frac{1}{3}}y^{\frac{1}{4}}} \times \frac{4x^{\frac{1}{2}}}{x^{\frac{3}{4}}y}$$

$$= \frac{3^1 \times 4 \times x^{\frac{2}{3} + \frac{1}{2}} \times y^{\frac{1}{5}}}{9^3 \times x^{\frac{1}{3} + \frac{3}{4}} \times y^{\frac{1}{4} + 1}}$$

$$= \frac{4}{3} \times \frac{x^{\frac{4}{6} + \frac{3}{6}}}{x^{\frac{4}{12} + \frac{9}{12}}} \times \frac{y^{\frac{1}{5}}}{y^{\frac{1}{4} + \frac{4}{4}}}$$

$$= \frac{4}{3} \times \frac{x^{\frac{7}{6}}}{x^{\frac{13}{12}}} \times \frac{y^{\frac{1}{5}}}{y^{\frac{5}{4}}}$$

$$= \frac{4}{3} \times x^{\frac{7}{6} - \frac{13}{12}} \times y^{\frac{1}{5} - \frac{5}{4}}$$

$$= \frac{4}{3} \times x^{\frac{14}{12} - \frac{13}{12}} \times y^{\frac{4}{20} - \frac{25}{20}}$$

$$= \frac{4}{3} \times x^{\frac{1}{12}} \times y^{-\frac{21}{20}}$$

$$= \frac{4}{3} \times x^{\frac{1}{12}} \times \frac{1}{y^{\frac{21}{20}}}$$

$$= \frac{4x^{\frac{1}{12}}}{3y^{\frac{21}{20}}}$$