NOTE: No Calculators.

1. Express the following integers as products of their prime factors in index form:
   (a) 36, (b) 540.

2. Solve for n:
   (a) $3^n = 81$, (b) $2^n = 128$.

3. Simplify these expressions, removing any brackets:
   (a) $3x^2 \times 5x^3$,
   (b) $a^3b^5 \div ab$,
   (c) $(4ab^3)^2$,
   (d) $x^3(x^5 - 3x^2)$,
   (e) $(2m^2n^3)^4 \div (2m^3n^2)^2$,
   (f) $(x^3 - 1)(x^3 + 1)$.

4. Express these numbers without zero or negative indices:
   (a) $(3x)^0$,
   (b) $7a^0 + 7^0a^0 + 7^0a$,
   (c) $\left(\frac{2}{5}\right)^{-1}$,
   (d) $3x^{-2}$,
   (e) $(xy)^{-1}$,
   (f) $(x^3)^{-2}$.

5. Write in standard notation, correct to 4 significant figures:
   (a) 56 298 123, (b) 0·000 087 448.

6. Calculate these numbers, giving your answers in standard notation:
   (a) $(3 \times 10^9) \times (4 \times 10^{15})$. (b) $(2 \times 10^{-16}) \div (5 \times 10^{-20})$.

7. Evaluate:
   (a) $9^{\frac{1}{2}}$,
   (b) $4^{-\frac{1}{2}}$,
   (c) $8^{\frac{2}{3}}$,
   (d) $\left(\frac{25}{4}\right)^{-\frac{3}{2}}$.

8. Simplify fully:
   (a) $x^{\frac{3}{4}} \times x^{\frac{1}{4}}$,
   (b) $(8m^3)^{\frac{1}{3}}$,
   (c) $\left(7^{\frac{2}{3}}\right)^3$,
   (d) $(0.04)^{-\frac{1}{2}}$.

9. Simplify each of the following expressions, giving your answer with positive indices.
   (a) $(xb^{-\frac{2}{3}})^{\frac{1}{3}} \times (x^{\frac{1}{4}}b^{-3})^{\frac{1}{3}}$
   (b) $\dfrac{(\frac{1}{2}a^3b^{-2})^{-1}}{(8a^{-9}b^6)^{\frac{1}{3}}}$

1. These are factorings into *primes*.

   (a) $36 = 2^2 \times 3^2$.

   (b) $540 = 2^2 \times 3^3 \times 5$.

2. (a) $3^n = 81$

   $n = 4$ (because $3^4 = 81$).

   (b) $2^n = 128$

   $n = 7$ (because $2^7 = 128$).

3. (a) $3x^2 \times 5x^3 = 15x^5$.

   (b) $a^3b^5 \div ab = a^2b^4$.

   (c) $(4ab^3)^2 = 16a^2b^6$.

   (d) $x^3(x^5 - 3x^2) = x^8 - 3x^5$.

   (e) $(2m^2n^3)^4 \div (2m^3n^2)^2$
   $= 16m^8n^{12} \div 4m^6n^4$
   $= 4m^2n^8$.

   (f) $(x^3 - 1)(x^3 + 1) = x^6 - 1$.

4. (a) $(3x)^0 = 1$.

   (b) $7a^0 + 7^0a^0 + 7^0a$
   $= 7 \times 1 + 1 \times 1 + 1 \times a$
   $= 7 + 1 + a$
   $= 8 + a$.

   (c) $\left(\frac{2}{5}\right)^{-1} = \frac{5}{2}$.

   (d) $3x^{-2} = \frac{3}{x^2}$ (the index -2 applies only to the x and not to the 3).

   (e) $(xy)^{-1} = \frac{1}{xy}$.

   (f) $(x^3)^{-2} = x^{-6}$
   $= \frac{1}{x^6}$.

5. Answers given to 4 significant figures.

   (a) $56\,298\,123 \doteqdot 5{\cdot}630 \times 10^7$.

   (b) $0{\cdot}000\,037\,448 \doteqdot 3{\cdot}745 \times 10^{-5}$.

6. (a) $(3 \times 10^9) \times (4 \times 10^{15})$
   $= 12 \times 10^{24}$
   $= 1{\cdot}2 \times 10 \times 10^{24}$
   $= 1{\cdot}2 \times 10^{25}$.

   (b) $(2 \times 10^{-16}) \div (5 \times 10^{-20})$
   $= (20 \times 10^{-17}) \div (5 \times 10^{-20})$
   $= 4 \times 10^3$.

7. (a) $9^{\frac{1}{2}} = 3$.

   (b) $4^{-\frac{1}{2}} = \frac{1}{4^{\frac{1}{2}}}$
   $= \frac{1}{2}$.

   (c) $8^{\frac{2}{3}} = 2^2$
   $= 4$.

   (d) $\left(\frac{25}{4}\right)^{-\frac{3}{2}} = \left(\frac{4}{25}\right)^{\frac{3}{2}}$
   $= \left(\frac{2}{5}\right)^3$
   $= \frac{8}{125}$.

8. (a) $x^{\frac{3}{4}} \times x^{\frac{1}{4}} = x$.

   (b) $(8m^3)^{\frac{1}{3}} = 2m$.

   (c) $\left(7^{\frac{2}{3}}\right)^3 = 7^2$
   $= 49$.

   (d) $(0.04)^{-\frac{1}{2}} = \left(\frac{1}{25}\right)^{-\frac{1}{2}}$
   $= 25^{\frac{1}{2}}$
   $= 5$.

9. (a) $\frac{x^{5/12}}{b^{11/9}}$

   (b) 1