

A Standard Form (Non-Calc)

(b) Write 0.000003 06 in standard form.

$$\underline{3.06 \times 10^{-6}} \quad [1]$$

8 Write in standard form.

(a) 3 706 000

$$\underline{3.706 \times 10^6} \quad [1]$$

(b) 0.001 010

$$\underline{1.01 \times 10^{-3}} \quad [1]$$

8 Calculate 0.3^2 .
Give your answer in standard form.

$$\begin{array}{l} 0.3 \times 0.3 \\ \text{two digits after d.p.} \\ 3 \times 3 = 9 \\ 0.3 \times 0.3 = 0.09 \\ \text{two digits after d.p.} \end{array}$$

$$\underline{9 \times 10^{-2}} \quad [2]$$

10 (a) Write 0.006 54 in standard form.

$$\underline{6.54 \times 10^{-3}} \quad [1]$$

(b) The number 1.467×10^{102} is written as an ordinary number.

Write down the number of zeros that follow the digit 7.

$$1.467 \times 10^{102}$$

↑
take up three of
the spaces

$$102 - 3 = 99$$

$$\underline{99} \quad [1]$$

- 13 Calculate $0.04^2 + 0.03 \times 0.28$.
Give your answer in standard form.

$$0.04 \times 0.04 = 0.0016$$

$(4 \times 4 = 16)$

$$0.03 \times 0.28 = 0.0084$$

$(3 \times 28 = 84)$

$$\begin{array}{r} 0.0016 \\ + 0.0084 \\ \hline 0.0100 \end{array}$$

$$= 0.01$$

$$= 1 \times 10^{-2} \quad [2]$$

- 7 (a) Write 0.00308 in standard form.

$$3.08 \times 10^{-3} \quad [1]$$

- (b) Work out $(7 \times 10^6) \times (3 \times 10^{-8})$.

Give your answer in standard form.

$$7 \times 3 \times 10^6 \times 10^{-8}$$

$$= 21 \times 10^{-2}$$

$$= 2.1 \times 10^1 \times 10^{-2}$$

$$= 2.1 \times 10^{-1}$$

$$2.1 \times 10^{-1} \quad [2]$$

- 9 (a) Write 0.00709 in standard form.

$$7.09 \times 10^{-3} \quad [1]$$

- (b) Work out $(4 \times 10^4)^2$.

Give your answer in standard form.

$$4^2 \times (10^4)^2$$

$$= 16 \times 10^8$$

$$= 1.6 \times 10^1 \times 10^8$$

$$= 1.6 \times 10^9$$

$$1.6 \times 10^9 \quad [2]$$

- 12 Simplify $(3 \times 10^{85}) \times (7 \times 10^{15})$.

Give your answer in standard form.

$$\begin{aligned} & 3 \times 7 \times 10^{85} \times 10^{15} \\ &= 21 \times 10^{100} \\ &= \underbrace{21}_{2.1 \times 10^1} \times 10^{100} \\ &= 2.1 \times 10^{101} \end{aligned}$$

$$\underline{\quad 2.1 \times 10^{101} \quad} [2]$$

- 16 Calculate $(3 \times 10^{-3})^3$.

Give your answer in standard form.

$$\begin{aligned} & 3^3 \times (10^{-3})^3 \\ &= 27 \times 10^{-9} \\ &= \underbrace{27}_{2.7 \times 10^1} \times 10^{-9} \\ &= 2.7 \times 10^{-8} \end{aligned}$$

$$\underline{\quad 2.7 \times 10^{-8} \quad} [1]$$

7 $p = 5 \times 10^7$

Work out p^3 .

Give your answer in standard form.

$$\begin{aligned} & 5^3 \times (10^7)^3 \\ &= 125 \times 10^{21} \\ &= \underbrace{125}_{1.25 \times 10^2} \times 10^{21} \\ &= 1.25 \times 10^{23} \end{aligned}$$

$$\underline{\quad 1.25 \times 10^{23} \quad} [2]$$

11 $10 < ab < 100$

Simplify $(a \times 10^7) \times (b \times 10^8)$.
Give your answer in standard form.

$$\begin{aligned}
 & a \times b \times 10^7 \times 10^8 \\
 & = ab \times 10^{15} \quad \text{but } ab \text{ needs to be between 1 and 10} \\
 & = \frac{ab}{10} \times 10^1 \times 10^{15} \\
 & = \frac{ab}{10} \times 10^{16}
 \end{aligned}$$

$$\frac{ab}{10} \times 10^{16} \quad [2]$$

8 $p = 2 \times 10^3$ $q = 8 \times 10^{-5}$

Work out the following, giving each answer in standard form.

(a) pq

$$\begin{aligned}
 & 2 \times 8 \times 10^3 \times 10^{-5} \\
 & = 16 \times 10^{-2} \\
 & = 1.6 \times 10^1 \times 10^{-2} = 1.6 \times 10^{-1}
 \end{aligned}$$

$$1.6 \times 10^{-1} \quad [2]$$

(b) $\frac{p}{q}$

$$\begin{aligned}
 & \frac{2 \times 10^3}{8 \times 10^{-5}} = \frac{2}{8} \times \frac{10^3}{10^{-5}} \\
 & = 0.25 \times 10^8 \\
 & = 2.5 \times 10^{-1} \times 10^8 \\
 & = 2.5 \times 10^7
 \end{aligned}$$

$$2.5 \times 10^7 \quad [2]$$

- 6 (a) Write 0.0000586 in standard form.

$$5.86 \times 10^{-5} \quad [1]$$

- (b) $(2 \times 10^a) \div (8 \times 10^b) = k \times 10^n$ where $1 \leq k < 10$.

- (i) Find the value of k .

$$\frac{2}{8} \times \frac{10^a}{10^b} = 0.25 \times 10^{a-b}$$

$$= 2.5 \times 10^{-1} \times 10^{a-b}$$

$$k = 2.5 \quad [1]$$

- (ii) Write an expression for n in terms of a and b .

$$2.5 \times 10^{-1} \times 10^{a-b}$$

$$= 2.5 \times 10^{a-b-1}$$

$$n = a - b - 1 \quad [1]$$

- 12 Work out, giving your answer in standard form,

- (a) $(7.1 \times 10^{-15}) \times (2 \times 10^3)$

$$7.1 \times 2 \times 10^{-15} \times 10^3$$

$$= 14.2 \times 10^{-12}$$

$$= 1.42 \times 10^1 \times 10^{-12}$$

$$= 1.42 \times 10^{-11}$$

$$1.42 \times 10^{-11} \quad [2]$$

- (b) $(5.2 \times 10^7) + (5.2 \times 10^6)$

change both to highest base (in this case 10^7):

$$5.2 \times 10^7 + 0.52 \times 10^1 \times 10^6$$

$$= 5.2 \times 10^7 + 0.52 \times 10^7 \rightarrow + \frac{5.2}{0.52}$$

$$= 5.72 \times 10^7$$

$$5.72 \times 10^7 \quad [2]$$

- 9 Calculate $4.8 \times 10^6 + 3.7 \times 10^7$.
Give your answer in standard form.

$$\begin{aligned}
 & 0.48 \times 10^1 \times 10^6 + 3.7 \times 10^7 \\
 = & 0.48 \times 10^7 + 3.7 \times 10^7 \rightarrow \begin{array}{r} 3.7 \\ + 0.48 \\ \hline 4.18 \end{array} \quad \underline{4.18 \times 10^7} \quad [1] \\
 = & 4.18 \times 10^7
 \end{aligned}$$

- 6 $p = 5 \times 10^{-8}$ $q = 6.8 \times 10^{-7}$

Find, giving your answers in standard form,

$$\begin{aligned}
 \text{(a) } pq & 5 \times 6.8 \times 10^{-8} \times 10^{-7} \\
 & = 34 \times 10^{-15} \\
 & = 3.4 \times 10^1 \times 10^{-15} \\
 & = 3.4 \times 10^{-14} \quad \underline{3.4 \times 10^{-14}} \quad [2]
 \end{aligned}$$

$$\begin{aligned}
 \text{(b) } p+q & \text{ change both to highest base } (10^{-7}) \\
 & 0.5 \times 10^1 \times 10^{-8} + 6.8 \times 10^{-7} \\
 = & 0.5 \times 10^{-7} + 6.8 \times 10^{-7} \rightarrow \begin{array}{r} 0.5 \\ + 6.8 \\ \hline 7.3 \end{array} \quad \underline{7.3 \times 10^{-7}} \quad [2] \\
 = & 7.3 \times 10^{-7}
 \end{aligned}$$

- 8 Calculate the value of $(2.3 \times 10^{-3}) + (6.8 \times 10^{-4})$.
Give your answer in standard form.

$$\begin{aligned}
 & 2.3 \times 10^{-3} + 0.68 \times 10^1 \times 10^{-4} \\
 = & 2.3 \times 10^{-3} + 0.68 \times 10^{-3} \rightarrow \begin{array}{r} 2.3 \\ + 0.68 \\ \hline 2.98 \end{array} \quad \underline{2.98 \times 10^{-3}} \quad [1] \\
 = & 2.98 \times 10^{-3}
 \end{aligned}$$

- 6 (a) Work out $(1.5 \times 10^1) \times (7 \times 10^{-3})$.
Give your answer in standard form.

$$1.5 \times 7 \times 10^1 \times 10^{-3}$$

$$= 10.5 \times 10^{-2}$$

$$= 1.05 \times 10^1 \times 10^{-2}$$

$$1.05 \times 10^{-1} \quad [2]$$

- (b) Work out $(6.5 \times 10^{-2}) + (7.8 \times 10^{-3})$.
Give your answer in standard form.

$$6.5 \times 10^{-2} + 0.78 \times 10^1 \times 10^{-3}$$

$$= 6.5 \times 10^{-2} + 0.78 \times 10^{-2} \rightarrow \begin{array}{r} 6.5 \\ + 0.78 \\ \hline 7.28 \end{array} \quad 7.28 \times 10^{-2} \quad [2]$$

$$= 7.28 \times 10^{-2}$$

- 14 Work out $(3 \times 10^{199}) + (2 \times 10^{201})$.
Give your answer in standard form.

$$3 \times 10^{199} + 2 \times 10^{201}$$

$$= 0.03 \times 10^2 \times 10^{199} + 2 \times 10^{201}$$

$$= 0.03 \times 10^{201} + 2 \times 10^{201}$$

$$= 2.03 \times 10^{201}$$

$$2.03 \times 10^{201} \quad [2]$$

7 Work out the following, giving each answer in standard form.

(a) $(4.3 \times 10^4) \times (3 \times 10^{-4})$

$$\begin{aligned} & 4.3 \times 3 \times 10^4 \times 10^{-4} \\ &= 12.9 \times 10^0 \\ &= 1.29 \times 10^1 \times 10^0 \end{aligned}$$

$$\underline{1.29 \times 10^1} \quad [2]$$

(b) $(6 \times 10^{-2}) + (3 \times 10^{-3})$

$$\begin{aligned} & 6 \times 10^{-2} + 0.3 \times 10^1 \times 10^{-3} \\ &= 6 \times 10^{-2} + 0.3 \times 10^{-2} \\ &= 6.3 \times 10^{-2} \end{aligned}$$

$$\underline{6.3 \times 10^{-2}} \quad [2]$$

10 $c = 4 \times 10^7$ $d = 5.8 \times 10^6$

Work out, giving your answers in standard form,

(a) c^2 , $4^2 \times (10^7)^2$

$$\begin{aligned} &= 16 \times 10^{14} \\ &= 1.6 \times 10^1 \times 10^{14} \end{aligned}$$

$$\underline{1.6 \times 10^{15}} \quad [2]$$

(b) $c - d$.

$$\begin{aligned} & 4 \times 10^7 - 0.58 \times 10^1 \times 10^6 \\ &= 4 \times 10^7 - 0.58 \times 10^7 \rightarrow \begin{array}{r} 4.00 \\ - 0.58 \\ \hline 3.42 \end{array} \\ &= 3.42 \times 10^7 \end{aligned}$$

$$\underline{3.42 \times 10^7} \quad [2]$$

11 (a) Write 0.007 08 in standard form.

$$\underline{7.08 \times 10^{-3}} \quad [1]$$

(b) Work out $(3.8 \times 10^{22}) + (3.8 \times 10^{23})$.

Give your answer in standard form.

$$\begin{aligned} & 0.38 \times 10^1 \times 10^{22} + 3.8 \times 10^{23} \\ = & 0.38 \times 10^{23} + 3.8 \times 10^{23} \rightarrow \begin{array}{r} 3.8 \\ + 0.38 \\ \hline 4.18 \end{array} \\ = & 4.18 \times 10^{23} \end{aligned}$$

$$\underline{4.18 \times 10^{23}} \quad [2]$$

13 Work out $2 \times 10^{100} - 2 \times 10^{98}$, giving your answer in standard form.

$$\begin{aligned} & 2 \times 10^{100} - 0.02 \times 10^2 \times 10^{98} \\ = & 2 \times 10^{100} - 0.02 \times 10^{100} \rightarrow \begin{array}{r} 2.00 \\ - 0.02 \\ \hline 1.98 \end{array} \\ = & 1.98 \times 10^{100} \end{aligned}$$

$$\underline{1.98 \times 10^{100}} \quad [2]$$

(d) Write 0.00701 in standard form.

$$\underline{7.01 \times 10^{-3}} \quad [1]$$

(e) Simplify $1.5 \times 10^x + 1.5 \times 10^{x-1}$ giving your answer in standard form.

$$\begin{aligned} & 1.5 \times 10^x + 0.15 \times 10^1 \times 10^{x-1} \\ = & 1.5 \times 10^x + 0.15 \times 10^x \rightarrow \begin{array}{r} 1.5 \\ + 0.15 \\ \hline 1.65 \end{array} \quad \underline{1.65 \times 10^x} \quad [2] \\ = & 1.65 \times 10^x \end{aligned}$$

14 In this calculation, the three numbers are written in standard form.

$$(4 \times 10^p) \times (n \times 10^{p+2}) = 3.2 \times 10^t$$

n , p and t are integers.

(a) Find the value of n .

$$4 \times n \times 10^p \times 10^{p+2} = 3.2 \times 10^t$$

$$= 4n \times 10^{2p+2} = 3.2 \times 10^t$$

Given n is an integer and the numbers are in standard form,

$$4n = 32$$

(disregard decimal point in 3.2)

$$n = 8 \quad [1]$$

(b) Find t in terms of p .

$$4 \times 8 \times 10^{2p+2} = 3.2 \times 10^t$$

$$= 32 \times 10^{2p+2} = 3.2 \times 10^t$$

$$= 3.2 \times 10^1 \times 10^{2p+2} = 3.2 \times 10^t$$

$$= 3.2 \times 10^{2p+3} = 3.2 \times 10^t$$

$$t = 2p + 3 \quad [1]$$

20 Simplify $2.1 \times 10^p + 2.1 \times 10^{p-1}$.
Give your answer in standard form.

$$2.1 \times 10^p + 0.21 \times 10^1 \times 10^{p-1}$$

$$= 2.1 \times 10^p + 0.21 \times 10^p \rightarrow \begin{array}{r} 2.1 \\ + 0.21 \\ \hline 2.31 \end{array} \quad 2.31 \times 10^p \quad [2]$$

$$= 2.31 \times 10^p$$