1.3 Indices, surds, standard form and bounds

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS standard form • upper bound • error interval

Objective

Use index laws, standard form, estimation and bounds. Original questions for rules N7–N9, N14–N16.

1 Key knowledge and worked examples

- **Index laws**: a^m × a^n = a^(m+n); a^m ÷ a^n = a^(m−n); (a^m)^n = a^(mn); a^0 = 1; a^(−n) = 1/a^n; a^(1/2) = √a; *(H)* a^(m/n) = the n-th root of a^m.
- **(H) Surds**: √12 = 2√3; rationalise 1/√2 × √2/√2 = √2/2; conjugate pairs for 1/(3+√2).
- **Standard form**: $A \times 10^n$ with $1 \leq A < 10$; $(4 \times 10^5) \times (3 \times 10^{-2}) = 1.2 \times 10^4$.
- **Estimation**: round each to 1 significant figure; state over- or under-estimate with a reason.
- **(H) Bounds**: 9 m to the nearest metre → $8.5 \leq L < 9.5$; UB(×) uses UBs; UB(÷) = UB ÷ LB. Round the final bound sensibly.

Worked example (3 marks, H). The length is 9 m (nearest metre) and width 4 m (nearest metre). Work out the upper bound of the perimeter.

UB length = 9.5, UB width = 4.5; UB perimeter = 2(9.5 + 4.5); = 28 m.

2 Practice

2.1 Simplify $7^5 \times 7^2$. [1]

2.2 Write 0.00052 in standard form. [2]

2.3 Estimate 412×29 by rounding each number to one significant figure. [2]

3 Exam-style questions

3.1 Work out $(3 \times 10^4) \div (6 \times 10^{-3})$, giving your answer in standard form. [3]

3.2 *(H)* Simplify fully $\sqrt{48} + \sqrt{27}$. [3]

3.3 *(H)* The mass of a parcel is 3.6 kg to 1 d.p. and the mass of a box is 1.2 kg to 1 d.p. Work out the upper bound of the total mass. [3]

Solutions

2.1 7^7.

2.2 5.2×10^{-4}.

2.3 400×30; $= 12\ 000$.

3.1 $3 \div 6 = 0.5$; $10^4 \div 10^{-3} = 10^7$; $= 0.5 \times 10^7 = 5 \times 10^6$.

3.2 $\sqrt{48} = 4\sqrt{3}$; $\sqrt{27} = 3\sqrt{3}$; sum $= 7\sqrt{3}$.

3.3 UBs: 3.65 and 1.25; total $= 3.65 + 1.25$; $= 4.9$ kg.