Power First: Reading and Comparing Standard Form

Teacher		**Class**	Year 9
Subject	Maths	**Topic**	Standard form
Date		**Room**	
Lesson length	60 minutes	**Country**	United Kingdom

Students learn to read A x 10n and tell if it is big, tiny or near A. They order standard-form numbers power first, then by A.

Curriculum links

- interpret and compare numbers in standard form A x 10n, 1 ≤ A < 10, where n is a positive or negative integer or 0
- Order numbers in standard form [1]

Learning objectives

- Students will interpret standard form with positive, negative and zero powers.
- Students will compare and order standard-form numbers by power then front value.

Success criteria

- I can read A x 10n and say if it is big, tiny or near A.
- I can compare two standard-form numbers power first, then A.
- I can order a set of standard-form numbers smallest to largest.

What students already know

2-minute whiteboard check: What is 3.2 x 1000? What is 3.2 ÷ 1000? Listen for moving digits left for big and right for tiny.

Key words

standard form	a short way to write very big or very tiny values using a value times a ten power [3][4]
power of ten	a small raised number showing how many times 10 is multiplied by itself [6]
ordinary number	a value written out fully with digits, without using ten powers [4][6]
compare	to say which value is bigger or smaller and explain why [18]

Materials

- Mini whiteboards and pens
- List of paired numbers from Slides 5 and 9
- Slides 1-2, 4-7, 8-12 and video clips 1-2
- Printed Worksheet Task A, Task B and Task F, one copy per pair

Before the lesson

- Print Worksheet Tasks A, B and F, one per pair, plus a few spare copies
- Test Slides 1-2, 4-12 and Video clip 1 (0:00–3:05) and Video clip 2 (0:00–4:28) with sound
- Set tables for pairs with mini whiteboards, pens and a place-value mat per pair
- Write the six Slide 9 numbers on the board for quick ordering: 7x10-2, 9x100, 5x102, 1.5x103, 3.2x103, 4.1x105

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Lesson outline

0–8 min **Starter** 8 min · Whole class

To hook interest in shortcut comparing and recall multiplying by powers of 10.

YOU DO

1. Show Slide 1: Big or Tiny? Reading Standard Form and state today's focus on reading and comparing.
2. Say the hook and show Slide 2 mystery: 305,000 = 3.05 x 10^5 with calculator showing 3.05 E5.
3. Model breaking 305,000 into 3.05 x 100,000 to get 3.05 x 10^5 [6].
4. Ask pairs to write the hidden ordinary number and whether the power tells big or tiny.

STUDENTS DO

1. Discuss with partner what 3.05 E5 could hide.
2. Write guess 305,000 on whiteboards and hold up.
3. Say why power 5 means big, not tiny.

Say: You do not need to work out the whole number to know which is bigger. Want to see the shortcut? Today we read big and tiny numbers the short way. Look at this calculator mystery and tell me what it hides.

Worked example: 305,000 = 3.05 x 100,000 = 3.05 x 10^5 [6]. Front 3.05 fits $1 \leq A < 10$ [2]. Power 5 means digits move 5 places left, so the value is big.

Ask: What ordinary number is 3.05 E5 hiding? (305,000, which is 3.05 x 10^5 [6].) · How does the power tell you it is big? (Positive power means digits move left and the number gets big.)

Check understanding: Scan whiteboards for 305,000. If many miss, quickly show $10^3 = 1000$ and $10^{-3} = 0.001$ [6] on a place-value strip and re-ask.

Support: Give a place-value strip marked with $10^3 = 1000$ and $10^{-3} = 0.001$ [6] so students only move one to three places. **Stretch:** Ask what 3.05 x 10^0 would be and why it stays near A.

Use: Slides 1-2

8–20 min **Teaching: what counts** 12 min · Whole class

To teach the rule for standard form and spot fakes fast.

YOU DO

1. Play Video clip 1 (0:00–3:05) on Slide 6: What counts as standard form? Ask pupils to listen for big vs tiny powers.
2. Show Slide 7 cards and state the rule: A x 10n, where A is greater than or equal to 1 but less than 10 and n is any integer [3].
3. Model sorting: 2.5×10^{-2} is in standard form, while 25×10^{-3} and 0.025 are not [3].
4. Model that 3.2×10^{3} is 3200 [3] because $10^{3} = 1000$ [6] and front 3.2 fits $1 \leq A < 10$ [2].

STUDENTS DO

1. Watch the clip and note the rule $1 \leq A < 10$.
2. On whiteboards write S or Sham for each card the teacher shows.
3. Explain to partner why each fake fails the rule for A.

Say: Standard form always has two parts multiplied. The front stays between 1 and under 10. The power tells you how far and which way the digits move.

Worked example: 2.5×10^{-2} is standard form because 2.5 fits $1 \leq A < 10$ [2]. 25×10^{-3} is not, because 25 is too big [3]. 0.025 is not, because there is no x10n part [3]. 3.25×10^{8} is standard form [3].

Ask: Why is 25×10^{-3} not standard form? (A = 25 is not less than 10, it breaks $1 \leq A < 10$ [2][3].) · Why is 0.025 not standard form? (It has no multiplication by a power of 10 [3].) · What does n = -2 tell you about size? (Digits move right, so the number is tiny, closer to 0 [1].)

Check understanding: Cold-call S/Sham show for 3 cards. If errors, re-display rule $1 \leq A < 10$ [2] and sort two more together.

Support: Give cards where A = 25 or A = 0.025 with reminder $1 \leq A < 10$ [2] so the break is clear. **Stretch:** Ask pupils to explain why A must be at least 1 and less than 10 [3].

Use: Slides 6-7, Video clip 1 (0:00–3:05)

20–32 min **Interpreting to ordinary** 12 min · Pairs

To link standard form to ordinary numbers for very big, very small and n = 0.

YOU DO

1. Show Slide 4: $3x10^{8}$ metres per second in standard form and note huge measures are shorter and clearer this way.
2. Play Video clip 2 (0:00–4:28) on Slide 8 and ask pupils to watch how digits shift and notice 10^{0} leaves A unchanged.
3. Model 3×10^{8} m/s is the speed of light [4] = 300,000,000 and 1.93×10^{2} is 193 [3].
4. Hand out Worksheet Task A and set 5 minutes to link each bar to its ordinary number.

STUDENTS DO

1. Watch and record one big and one tiny shift from the video.
2. Complete Worksheet Task A: use each bar to link standard form to its ordinary number.
3. Tell partner for each match if it is big, tiny or near A.

Say: The power shows the size, the front number shows the detail. Positive moves digits left to make big. Negative moves digits right to make tiny. Zero leaves A where it is.

Worked example: $3 \times 10^{8} = 3 \times 100{,}000{,}000 = 300{,}000{,}000$, the speed of light in m/s [4]. 1.93×10^{-1} is 0.193 [3]. $9 \times 10^{0} = 9 \times 1 = 9$, because any value to the power 0 always = 1 [1] and for numbers between 1 and 10 the power is zero [4].

Ask: How do you read 1.93×10^{-1} as ordinary? (0.193, digits move 1 place right because power is negative [3].) · What is 9×10^{0} and why? (9, because $10^{0} = 1$ [1] so A is unchanged.)

Check understanding: Check Task A bars by hands up for each match. If mixed, re-model one bar on visualiser with place-value moves.

Support: Provide the ordinary-number forms to copy and label, with reminder $10^{-4} = 0.0001$ [6]. **Stretch:** Ask pupils to explain what happens with n = 0 and why the number hardly changes.

Use: Slide 4, Slide 8, Video clip 2 (0:00–4:28), Worksheet Task A

32–50 min **Main activity: Power First Talk** 18 min · Pairs

To compare and order standard-form numbers power first, then A.

YOU DO

1. Show Slide 5 question: Which is bigger: $4.2x10^6$ or $9.8x10^5$ — and how do you know fast? Model circling powers.
2. Teach the shortcut: a larger power of 10 always means a larger number, only compare A when powers are equal [18], and the exponent can tell how large or small the number will be [11].
3. Set Slide 9 task: Order six numbers smallest to largest. Copy: $7x10^{-2}$, $9x10^0$, $5x10^2$, $1.5x10^3$, $3.2x10^3$, $4.1x10^5$. Order by power first, then by A. Hand out Task B and Task F.
4. Show Slide 10 cards to fix same-power ties, e.g. larger A wins like 6.1 > 2.3, and -2 is larger than -5.

STUDENTS DO

1. Circle powers on Task B and decide bigger by power first with partner.
2. Order the six Slide 9 numbers and write full list in both forms.
3. Complete Task F: circle power first, then compare A only for ties, and write one-sentence reasons.

Say: Check power first. Bigger n means bigger number for positives. If powers tie, then larger A wins. Circle the power first, then look at A only for ties.

Worked example: 4.2×10^6 beats 9.8×10^5 because power 6 > 5, so no full conversion is needed [18]. Ordered set: $7 \times 10^{-2} = 0.07$, $9 \times 10^0 = 9$, $5 \times 10^2 = 500$, $1.5 \times 10^3 = 1500$, $3.2 \times 10^3 = 3200$ [3], $4.1 \times 10^5 = 410{,}000$. Tie $3.2 \times 10^3 > 1.5 \times 10^3$ because 3.2 > 1.5 when powers match [18].

Ask: Which is bigger: $4.2x10^6$ or $9.8x10^5$, and how do you know fast? (4.2x10⁶, because power 6 beats power 5 [18].) · With same power, $1.5x10^3$ vs $3.2x10^3$, what decides? (A decides, 3.2 > 1.5 so $3.2x10^3$ is larger [18].) · Where does $9x10^0$ sit in the order and why? (Second smallest, after 0.07, because $10^0 = 1$ so it is 9 [1][4].)

Check understanding: Pairs hold up ordered lists. Scan for power-first errors. If stuck, show two numbers with powers circled and re-ask which power is larger [18].

Support: Show the two numbers with the powers circled, with a prompt that a larger power of 10 means a larger number [18]. **Stretch:** Students debate a tricky pair with the same power but different A values and explain their reasoning.

Use: Slides 5, 9-10, Worksheet Task B, Worksheet Task F

50–60 min **Plenary** 10 min · Whole class

To check interpreting and comparing and link to real tiny and huge uses.

YOU DO

1. Show Slide 11 vote: $3x10^{8}$ m/s speed of light, $8x10^{-5}$ m width of a hair, $4.3x10^{4}$ people in a crowd. Ask which is most helpful in standard form.
2. Draw out that scientists use standard form for the speed of light and for tiny things like bacteria or atoms [9], with hair width 8 x 10^{-5} metres [11] and light 3 x 10^{8} m/s [4].
3. Show Slide 12 True or false and poll each line, fixing that negative power makes tiny, not negative.
4. Set exit ticket on whiteboards: order three and spot the fake.

STUDENTS DO

1. Vote for most helpful shorthand and justify with big vs tiny powers.
2. Answer Slide 12 True or false on whiteboards.
3. Complete exit ticket: write three in order and name the non-standard one.

Say: One page can show a hair and light moving. The sign of the power tells tiny or huge. Tell me which vote you pick and prove it with powers. Then show me you can spot fakes.

Ask: Is 10^{4} four 10s multiplied and $3.2x10^{4}$ means 3.2 x10x10x10x10? (True, 10^{4} = 10,000 [6].) · Is $2.5x10^{-2}$ greater than $2.5x10^{2}$? (False, positive power 2 gives the larger number [18].)

Check understanding: Exit whiteboards: order $2.5x10^{-2}$, $2.5x10^{2}$ and $2.5x10^{0}$. If errors, revisit power-first rule and re-poll Slide 12.

Support: Give a number line 0.001 to 1000 marked 10^{-3} = 0.001 and 10^{3} = 1000 [6] to place each value.
Stretch: Ask pupils to add a middle strip for numbers near 1 and explain their power choice.

Use: Slides 11-12

Common mistakes

Mistake	How to spot it	How to fix it
Writing A outside 1 ≤ A < 10, e.g. 25 x 10^{-3} or 46 x 10^{-20}	Front has two digits or starts 0. when circling A	Move one digit to make A a decimal between 1 and under 10 and adjust power by 1, because standard form needs 1 ≤ A < 10 [2][3].
Thinking a negative power makes a negative number	Pupil says 7.601 x 10^{-3} is below zero	Show 0.007601 = 7.601 x 10^{-3} [4] on a place-value chart: digits move right, value gets tiny and closer to 0, not negative [1].
Comparing A first and ignoring the power	Pupil says 9.8 x 10^{5} beats 4.2 x 10^{6} because 9.8 > 4.2	Re-circle powers and remind that larger power means larger number, only compare A when powers match [18].

Support

- Show the two numbers with the powers circled, with a prompt that a larger power of 10 means a larger number [18].
- Provide ordinary-number forms to copy and label, with a reminder that 10^{-4} = 0.0001 [6].

Stretch

- Students debate a tricky pair with the same power but different A values and explain their reasoning.
- Students explain what happens with n = 0 and why the number hardly changes.

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- Let pupils place A on a place-value mat and show that multiplying by 1 does not move digits, since any value to the power 0 always = 1 [1].
- Students write one extra pair of their own where the powers are equal but the A values decide the order.

For the LSE or teaching assistant

Stay with the two focus pairs during Power First Talk. Prompt to circle powers first, check $1 \leq A < 10$, and ask them to read each value as big, tiny or near A before ordering.

Check for understanding

Question	Answer
Write 7×10^{-2} as an ordinary number. Is it big or tiny?	0.07, tiny because power is negative.
Which is larger: 4.2×10^{6} or 9.8×10^{5}? How do you know fast?	4.2×10^{6}, power 6 > 5 so larger power wins.
Which is not standard form: 4.1×10^{5}, 12×10^{3} or 1.5×10^{3}? Fix it.	12×10^{3} is not, A must fit $1 \leq A < 10$; fix to 1.2×10^{4}.

Homework

Order these smallest to largest and give power-first reason: 6x10-3, 6x100, 6x103.

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