Prime Codes, Shared Factors and Meeting Multiples

Teacher		**Class**	Year 7
Subject	Maths	**Topic**	Prime factors, HCF and LCM
Date		**Room**	
Lesson length	60 minutes	**Country**	United Kingdom

Pupils build numbers from primes and write them with indices. They sort prime cards in a Venn diagram to find HCF and LCM.

Curriculum links

- use the concepts and vocabulary of prime numbers, factors (or divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, including using product notation and the unique factorisation property
- developing number sense and working with prime numbers [2]

Learning objectives

- Students will use vocabulary of primes, factors, multiples and common factors and multiples.
- Students will write prime factorisation using product notation and index form.
- Students will find HCF and LCM from prime factors using Venn diagrams.

Success criteria

- I can identify primes and list factors, multiples and common factors and multiples.
- I can write a number as a product of primes with indices.
- I can find HCF and LCM from prime factors in a Venn diagram.

What students already know

Ask: Is 7 prime? What are factors of 12? Name a multiple of 6. Pupils show answers on mini-whiteboards in 2 minutes.

Key words

prime number	a whole number above 1 with only two exact divisors, 1 and itself [5]
factor	a whole number that goes into another number exactly with nothing left over [5]
multiple	a number in the times table of another number [3]
highest common factor	the biggest number that divides two numbers exactly, found in the Venn overlap [3]
lowest common multiple	the smallest number found in the times tables of two numbers [3]
prime factorisation	writing a number using only × with numbers that cannot be split further, using powers for repeats [5]

Materials

- Slides 1–12 on board
- Slide 6 Video clip 1 Prime factorisation to HCF and LCM (0:00–2:47) tested

Before the lesson

- Print Worksheet Task C (page 3): Practice questions: Use prime factorisation to find LCM and HCF, one per pupil

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- chalk circles or hoops for Venn rings
- sets of number cards with prime factors for 18 and 30, plus stretch cards for 50 and 16
- mini-whiteboards and pens
- Worksheet Task C: Practice questions: Use prime factorisation to find LCM and HCF, one per pupil
- Make sets of prime number cards: 2, 3, 3 for 18 and 2, 3, 5 for 30; stretch set 2, 5, 5 and 2, 2, 2, 2
- Test Slide 6 Video clip 1 (0:00–2:47) for sound and subtitles
- Draw or lay out two large overlapping circles for the Venn diagram

Lesson outline

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

Recall primes, factors and multiples and hook pupils into shared primes.

YOU DO

1. Show Slides 1–2 to share the lesson title and objectives for the 60 minutes.
2. Say the hook: Two numbers are heading into the Venn rings — only the primes they share get to stand in the middle!
3. Show Slide 5 Think, pair, share question: Is 1 prime? Is 9 prime? How do you know?
4. Take answers and agree that primes have only 1 and itself as divisors.

STUDENTS DO

1. Listen to objectives and the Venn hook.
2. Discuss in pairs whether 1 and 9 are prime and why.
3. Share reasons with the class.

Say: Two numbers are heading into the Venn rings — only the primes they share get to stand in the middle! Turn to your partner and decide. Is 1 prime? Is 9 prime? Be ready to explain how you know.

Ask: Is 1 prime? How do you know? (No, it is not greater than 1 and has only one divisor, not two.) · Is 9 prime? How do you know? (No, 9 = 3 × 3, so it has divisors 1, 3 and 9.) · What is a factor of 12 and a multiple of 12? (Factor e.g. 3 or 4 divides 12 exactly; multiple e.g. 24 is in the 12 times table.)

Check understanding: Mini-whiteboards up for 1 and 9 with one reason each; re-explain primes if many write 1 or 9 as prime.

Support: Give a prime list 2, 3, 5, 7, 11 to test 1 and 9 against. **Stretch:** Ask why 2 is the only even prime and what makes it different.

Use: Slides 1–2, 5

8–20 min **Teaching: factor trees** 12 min · Whole class

Model splitting a number to primes and writing product notation with indices.

YOU DO

1. Show Slide 3 big idea and Slide 4 timeline for splitting into factor pairs.
2. Model 60 on the board: 60 into 10 and 6, then 10 into 2 and 5, 6 into 2 and 3, circling primes.
3. Play Video clip 1 (0:00–2:47) on Slide 6 and point out product notation like 2 cubed.
4. Write the final line in expanded and index form and stress finishing only at primes.

STUDENTS DO

1. Copy the tree for 60 and circle the primes 2, 2, 3, 5.
2. Watch the clip and listen for product notation and shared primes.
3. Write 60 in expanded product and in index form.

Say: We chop the number into any factor pair, then chop any branches that are still composite. When only primes are left we circle them. Then we write the number as a product using ×, and shorten repeats with powers.

Worked example: 60 = 10 × 6 = 2 × 5 × 2 × 3, so 2 × 2 × 3 × 5 = 60, written as 2^2 × 3 × 5 [5]. The power shows how many times the factor occurs [5].

Ask: When is a factor tree finished? (When every branch ends in a prime that cannot be split further [5].) · How do we write 2 × 2 × 3 × 5 more neatly? (As $2^2 \times 3 \times 5$, where the 2 shows two lots of 2 [5].)

Check understanding: All show 60 = $2^2 \times 3 \times 5$ on whiteboards; remodel the 10 and 6 split if many stop early.

Support: Give a half-started tree with the first split into 10 and 6 already drawn. **Stretch:** Write 90 = 2 × 3 × 3 × 5 using powers as $2 \times 3^2 \times 5$.

Use: Slides 3–4, 6, Video clip 1 (0:00–2:47)

20–30 min **Teaching: Venn for HCF and LCM** 10 min · Whole class

Show how the overlap gives HCF and the whole diagram gives LCM.

YOU DO

1. Write 18 = 2 × 3 × 3 and 30 = 2 × 3 × 5 on cards [3].
2. Sort cards into the Venn rings, placing shared primes 2 and 3 in the overlap.
3. Model HCF as the product of the overlap and LCM as the product of all numbers in the diagram [3].
4. Link to Slide 10 compare: HCF divides both numbers, LCM is shared in both times tables.

STUDENTS DO

1. Call out where each prime card goes and why.
2. Copy the Venn diagram with 2, 3 in the middle.
3. Record HCF = 6 and LCM = 90 with the multiplications.

Say: The middle holds only the primes they share. Multiply the middle to get the highest common factor. Multiply everything you see in the rings to get the lowest common multiple. That is why HCF uses shared primes and LCM uses every prime left.

Worked example: 18 = 2 × 3 × 3 and 30 = 2 × 3 × 5 [3]. Overlap is 2 and 3, so HCF = 2 × 3 = 6. All cards give LCM = 3 × 2 × 3 × 5 = 90 [3].

Ask: Which primes go in the overlap for 18 and 30? (2 and 3, because both numbers have them as prime factors [3].) · Why is HCF 6 but LCM 90? (HCF uses only overlapping primes, LCM uses maximum powers / all numbers in the diagram [4][3].)

Check understanding: Hinge on whiteboards: HCF of 18 and 30 is? If many say 90, re-sort overlap versus whole diagram.

Support: Keep the sorted prime cards visible and point to overlap for HCF, whole diagram for LCM. **Stretch:** Ask pupils to predict HCF if we added a third number that also has 2 × 3.

Use: Slides 7, 9–10

30–50 min **Main activity: Venn Winners** 20 min · Pairs

Practise finding HCF and LCM from prime factors using a Venn diagram.

YOU DO

1. Hand out hoops or show circles, sets of number cards and mini-whiteboards.
2. Direct pairs to draw trees for 18 and 30, write each as a product of primes, then sort cards into the Venn.
3. Circulate, asking pairs to state HCF as product of overlap and LCM as product of whole diagram.
4. Give stretch cards 50 = 2 × 5 × 5 and 16 = 2 × 2 × 2 × 2 for early finishers [3].

STUDENTS DO

1. Draw factor trees for 18 and 30 until only circled primes remain.
2. Sort prime cards into Venn rings and write HCF and LCM with working.
3. Complete Worksheet Task C: Practice questions: Use prime factorisation to find LCM and HCF.

Say: In pairs, factorise 18 and 30, then find their HCF and LCM. Draw the trees, write the products, sort the prime cards so shared primes stand in the middle. Write the HCF from the overlap and the LCM from everything.

Worked example: 18 = 2 × 3² and 30 = 2 × 3 × 5. Overlap 2 × 3 gives HCF = 6. Whole diagram 2 × 3 × 3 × 5 gives LCM = 90 [3].

Ask: How do you know your tree is finished? (All ends are circled primes; any composite must be split again [5].) · For 50 and 16, what goes in the middle and what is the LCM? (Only one 2 is shared; LCM = 2 × 2 × 2 × 2 × 5 × 5 = 400 [3].)

Check understanding: Each pair holds up Venn and HCF/LCM lines; check overlap only for HCF, if wrong send back to re-sort cards.

Support: Hand out the prime cards already written out so students only have to sort and multiply. **Stretch:** Challenge pairs with 50 = 2 × 5 × 5 and 16 = 2 × 2 × 2 × 2 to find a much larger LCM.

Use: Slide 9, Worksheet Task C: Practice questions: Use prime factorisation to find LCM and HCF

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

Secure unique factorisation and HCF versus LCM before the exit check.

YOU DO

1. Show Slide 11 mystery: I am 2 × 3 × 3 × 5, less than 100, what number am I?
2. Agree answer 90 and stress every integer greater than 1 has a unique prime factorisation [4].
3. Use Slide 10 to contrast HCF as biggest divider and LCM as first shared times-table number.
4. Show Slide 12 exit ticket and collect three answers on whiteboards.

STUDENTS DO

1. Solve the mystery and explain why the prime code cannot change.
2. Sort HCF versus LCM uses: equal pieces versus meeting again.
3. Answer the exit questions on whiteboards.

Say: The mystery number is 2 × 3 × 3 × 5, which makes 90 — and no other primes can make me. Order can change but the prime list cannot. That unique code is why Venn sorting works every time.

Worked example: 2 × 3 × 3 × 5 = 90, less than 100, and no other prime list makes 90 because every integer greater than 1 has a unique prime factorisation [4].

Ask: Why can there not be a different secret prime code for 60? (Every integer greater than 1 has a unique prime factorisation, e.g. 60 = 2 × 2 × 3 × 5 [4][5].) · When do we need HCF and when LCM? (HCF for biggest equal pieces dividing both; LCM for when multiples meet again.)

Check understanding: Read exit whiteboards for correct products, HCF and LCM; revisit Venn overlap if HCF still uses all factors.

Support: Provide writing frame 2^__ × 3^__ × 5^__ to fill by counting repeats. **Stretch:** Ask why 1 cannot be included in the code and what happens if you try.

Use: Slides 10–12

Common mistakes

Mistake	How to spot it	How to fix it
Stopping a factor tree at composite numbers such as 10 or 6	Product line still contains 10, 6 or 9 instead of only primes	Split every composite branch again until only circled primes remain, then write the product [5][4].
Confusing factors with multiples	Pupil lists 36 as a factor of 18 or 3 as a multiple of 18	Check: factors divide the number exactly; multiples are in its times table [3].
Omitting repeated primes and using all factors for HCF	Writes 18 as 2 × 3 and gives HCF of 18 and 30 as 90	Keep every repeat and multiply only the overlap for HCF, all cards for LCM; HCF uses minimum powers, LCM maximum powers [4][3].

Support

- Hand out the prime cards already written out so students only have to sort and multiply.
- Give half-started trees and index frames such as 2^__ × 3^__ × 5^__.
- Keep a multiplication grid to test if a number really divides exactly.

Stretch

- Challenge pairs with 50 = 2 × 5 × 5 and 16 = 2 × 2 × 2 × 2 to find a much larger LCM.
- Ask for LCM of three numbers in prime form and for 90 = 2 × 3² × 5 in both forms.
- Ask why 1 cannot be in the prime code and to write a sneaky wrong solution to detect.

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For the LSE or teaching assistant

Stay with the Venn Winners pairs: help sort pre-written prime cards into overlap versus outside, prompt circling primes only, and check HCF uses overlap and LCM uses all cards.

Check for understanding

Question	Answer
Write 18 as a product of primes using indices.	$18 = 2 \times 3 \times 3 = 2 \times 3^2$ [3]
Find the HCF of 18 and 30 from prime factors.	HCF = $2 \times 3 = 6$ from the overlap [3]
Find the LCM of 18 and 30 from prime factors.	LCM = $3 \times 2 \times 3 \times 5 = 90$ from all numbers in the diagram [3]

Homework

Factorise 60 and 90 into primes with indices, then find their HCF and LCM.

Sources

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