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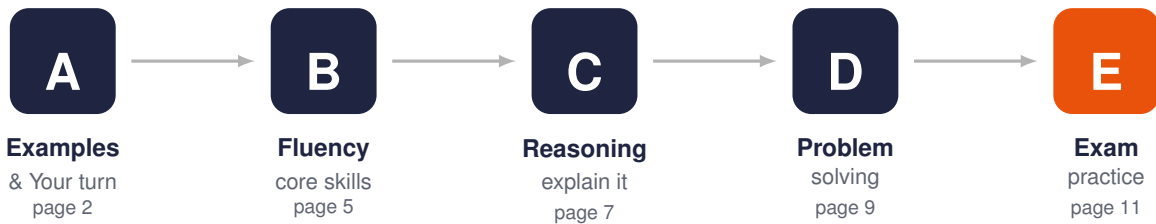
GCSE MATHEMATICS • NUMBER

# Factors, Multiples & Primes

## Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Free Factors, Multiples and Primes worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

**By the end of this worksheet you can:** find factors, multiples and primes • write a number as a product of prime factors • find the HCF and LCM and use them in problems • *Higher:* find the HCF and LCM from index form, decide what a prime factorisation tells you, and work backwards from an HCF and an LCM.

### Which questions are for me?

**FOUNDATION** Everyone starts here. These skills appear on both tiers.

**HIGHER** The same skills where Higher papers use them: reasoning from index form, building squares and cubes, and working backwards from an HCF and an LCM.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

### Track your progress

| Section          | B  | C  | D  | E  |
|------------------|----|----|----|----|
| Foundation marks | 20 | 11 | 15 | 13 |
| Higher marks     | 10 | 12 | 18 | 18 |
| My score         |    |    |    |    |

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**A****Worked examples & Your turn**

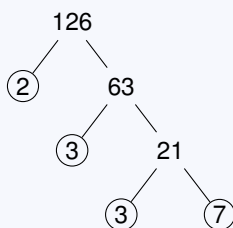
Read each example carefully. Cover it up, then answer the question beside it using the same method.

**FOUNDATION**

Everyone starts here

**Worked example A1: product of prime factors**

Write 126 as a product of its prime factors.



Keep splitting until every branch ends in a prime. Circle the primes.

$$126 = 2 \times 3 \times 3 \times 7$$

$$2 \times 3^2 \times 7$$

**Your turn A1**

Write 150 as a product of its prime factors.

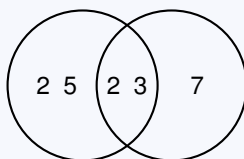
Give your answer in index form.

**Worked example A2: HCF and LCM with a Venn diagram**

Find the HCF and the LCM of 60 and 42

Write each number as a product of primes. Shared primes go in the overlap.

$$60 = 2 \times 2 \times 3 \times 5 \quad 42 = 2 \times 3 \times 7$$



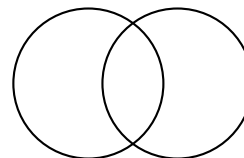
HCF = product of the overlap. LCM = product of everything in the diagram.

$$\text{HCF} = 2 \times 3 = 6 \quad \text{LCM} = 2 \times 5 \times 2 \times 3 \times 7 = 420$$

$$\text{HCF} = 6 \quad \text{LCM} = 420$$

**Your turn A2**

Find the HCF and the LCM of 36 and 90



**Worked example A3: when will it happen together again?**

A red light flashes every 8 seconds. A blue light flashes every 12 seconds. They flash together.

After how many seconds do they next flash together?

*"Together again" means a common multiple. The first time is the LCM.*

Multiples of 8: 8, 16, **24**, 32 ...

Multiples of 12: 12, **24**, 36 ...

24 seconds

**Your turn A3**

Bell A rings every 15 minutes. Bell B rings every 20 minutes. They ring together at 10 00

At what time do they next ring together?

**HIGHER**

*Higher strategies: these are new ways of thinking, not longer sums*

**Worked example A4: reading HCF and LCM from index form**

$$A = 2^3 \times 3 \times 5^2 \quad B = 2^2 \times 3^2 \times 7$$

Find the HCF and the LCM of  $A$  and  $B$ . Give the LCM in index form.

*HCF: for each prime in **both**, take the **lower** power.*

$$\text{HCF} = 2^2 \times 3 = 12$$

*LCM: for **every** prime, take the **higher** power.*

$$\text{LCM} = 2^3 \times 3^2 \times 5^2 \times 7$$

**Your turn A4**

$$P = 2^4 \times 5 \times 7^2 \quad Q = 2^3 \times 5^2 \times 11$$

Find the HCF and the LCM of  $P$  and  $Q$ . Give the LCM in index form.

**Worked example A5: building a square number**

$$504 = 2^3 \times 3^2 \times 7$$

Find the smallest whole number that 504 must be multiplied by to give a square number.

*In a square number every prime has an **even** power.*

$2^3$  needs one more 2.  $3^2$  is already even.  $7^1$  needs one more 7.

*Multiply by the missing primes.*

$$2 \times 7 = 14$$

14

**Your turn A5**

$$1350 = 2 \times 3^3 \times 5^2$$

Find the smallest whole number that 1350 must be multiplied by to give a square number.



**Worked example A6: working backwards from an HCF and an LCM**

Two numbers have an HCF of 15 and an LCM of 450. Both numbers are between 50 and 100

Find the two numbers.

*Both numbers are multiples of the HCF. Write them as  $15a$  and  $15b$ , where  $a$  and  $b$  share no factors.*

$$\text{LCM} = 15 \times a \times b = 450, \quad \text{so} \quad a \times b = 30$$

*List the pairs with no common factor:  $1 \times 30$ ,  $2 \times 15$ ,  $3 \times 10$ ,  $5 \times 6$ . Test them.*

$15 \times 5 = 75$  and  $15 \times 6 = 90$  are both between 50 and 100

75 and 90

**Your turn A6**

Two numbers have an HCF of 9 and an LCM of 378. Both numbers have two digits.

Find the two numbers.

**Worked example A7: counting factors from index form**

$$108 = 2^2 \times 3^3$$

How many factors does 108 have?

*Every factor is  $2^a \times 3^b$ . The power of 2 can be 0, 1 or 2 (3 choices). The power of 3 can be 0, 1, 2 or 3 (4 choices).*

*Add 1 to each power, then multiply.*

$$(2+1) \times (3+1) = 3 \times 4 = 12$$

12 factors

**Your turn A7**

$$112 = 2^4 \times 7$$

How many factors does 112 have?



**B****Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

**FOUNDATION***Everyone starts here*

**B1** Write down all the factors of

(a) 18

(b) 36

(c) 29

(d) 1

[4 marks]

**B2** (a) Write down the first five multiples of 7      (b) Write down the multiples of 6 between 50 and 70

(c) Write down all the prime numbers between 20 and 40      (d) Which of 51, 53, 57 and 59 are prime?

[4 marks]

**B3** Write each number as a product of its prime factors. Use index form where you can.

(a) 24

(b) 90

(c) 196

(d) 97

[4 marks]

**B4** Find the highest common factor (HCF) of

(a) 12 and 18

(b) 12 and 35

(c) 16 and 48

(d) 56 and 98

[4 marks]

**B5** Find the lowest common multiple (LCM) of

(a) 4 and 6

(b) 5 and 7

(c) 6 and 18

(d) 28 and 42

[4 marks]



**HIGHER***Higher tier only*

**B6**  $A = 2^2 \times 3^3 \times 5$      $B = 2^3 \times 3 \times 7$      $C = 2 \times 3^2 \times 5^2$

- (a) Find the HCF of  $A$  and  $B$ .    (b) Find the LCM of  $A$  and  $B$ . Give your answer in index form.  
(c) Find the HCF of  $A$ ,  $B$  and  $C$ .    (d) Find the LCM of  $A$ ,  $B$  and  $C$ . Give your answer in index form.

**[4 marks]**

**B7** (a)  $N = 2^4 \times 3^2 \times 5^2$  Show that  $N$  is a square number and find  $\sqrt{N}$ .

- (b) Find the smallest whole number that  $2^3 \times 3 \times 5^2$  must be multiplied by to give a square number.  
(c) Find the smallest whole number that  $2^2 \times 3 \times 5^4$  must be multiplied by to give a cube number.  
(d) How many factors does  $2^3 \times 5^2$  have?

**[4 marks]****B8** For any two numbers,  $\text{HCF} \times \text{LCM} = \text{the product of the two numbers}$ .

- (a) Two numbers have HCF 6 and LCM 90. One number is 18. Find the other.  
(b) Two numbers have HCF 5 and LCM 175. One number is 25. Find the other.

**[2 marks]**

**C****Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

**FOUNDATION**

*Everyone starts here*

- C1** Is 1 a prime number? Give a reason for your answer. [2 marks]
- C2** Jo writes  $140 = 2 \times 7 \times 10$   
Explain why this is not a product of prime factors, and write 140 correctly as a product of its prime factors. [2 marks]
- C3** (a) Tim says, "All prime numbers are odd." Give an example to show that Tim is wrong.  
(b) Eve says, "The sum of two prime numbers is always even." Give an example to show that Eve is wrong. [2 marks]
- C4** (a) Write down all the factors of 16  
(b) Most numbers have an even number of factors. Explain why square numbers have an odd number of factors. [3 marks]
- C5**  $p$  and  $q$  are two different prime numbers.  
Explain why the LCM of  $p$  and  $q$  is always  $p \times q$ . [2 marks]



**HIGHER***Higher tier only*

**C6**  $N = 2^3 \times 3 \times 7^2$

Without working out the value of  $N$ , decide whether  $N$  is divisible by **(a)** 12 **(b)** 9 **(c)** 28

Give a reason for each answer.

**[3 marks]****C7** The LCM of  $x$  and 90 is 630Find the smallest possible value of  $x$ . You must show your working.**[3 marks]****C8**  $p$  and  $q$  are two different prime numbers.**(a)** List all the factors of  $p^2q$ . **(b)** How many factors does  $p^2q^2$  have?**[3 marks]****C9** Prove that two consecutive whole numbers always have a highest common factor of 1**[3 marks]**

**D****Problem solving**

You decide the method. Read the whole question first, and show every step.

**FOUNDATION** *Everyone starts here*

- D1** Trains to Ayr leave a station every 16 minutes. Trains to Perth leave the same station every 28 minutes. A train to Ayr and a train to Perth both leave at 7 30 am.  
At what time do trains to Ayr and Perth next leave together? [3 marks]
- D2** Sausages are sold in packs of 12. Bread rolls are sold in packs of 9.  
Leo wants exactly the same number of sausages and bread rolls.  
What is the smallest number of packs of each that he can buy? [3 marks]
- D3** Priya has two ribbons. One is 90 cm long and the other is 126 cm long.  
She cuts both ribbons into pieces that are all the same length, with no ribbon left over.  
(a) What is the greatest possible length of each piece?      (b) How many pieces does she get altogether? [3 marks]
- D4** A number is a factor of 180, a multiple of 12, and is between 40 and 100.  
Find the number. You must show your working. [3 marks]
- D5** Three lights flash every 6 seconds, every 10 seconds and every 15 seconds. They all flash together at the start.  
How many more times do all three lights flash together in the next 5 minutes? [3 marks]



**HIGHER***Higher tier only*

- D6** Find the smallest whole number that is divisible by every whole number from 1 to 10  
You must show your working using prime factors. [3 marks]
- D7**  $N = 2^3 \times 3^2 \times 5$   
Find the smallest whole number  $k$  so that  $kN$  is a cube number. [3 marks]
- D8** Two numbers have an HCF of 10 and an LCM of 700. Both numbers are between 60 and 110  
Find the two numbers. [4 marks]
- D9** Gear A has 18 teeth and gear B has 30 teeth. The gears are joined so that the teeth mesh.  
A red dot on gear A is touching a red dot on gear B.  
How many complete turns does **each** gear make before the two red dots next touch? [4 marks]
- D10** Find the smallest whole number that has exactly 12 factors. You must show how you know it is the smallest. [4 marks]



**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

**FOUNDATION***Foundation and Higher crossover*

**E1** (a) Write down all the factors of 30

.....

**(2)**

(b) Write down a prime number between 40 and 50

.....

**(1)**

**(Total for Question E1 is 3 marks)**

**E2** Write 396 as a product of its prime factors.

Give your answer in index form.

.....

**(Total for Question E2 is 3 marks)**



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**E3** (a) Find the highest common factor (HCF) of 78 and 130

.....  
(2)

(b) Find the lowest common multiple (LCM) of 14 and 35

.....  
(2)

(Total for Question E3 is 4 marks)

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**E4** One alarm rings every 35 minutes. A second alarm rings every 50 minutes.  
Both alarms ring at 6 00 am.  
At what time do both alarms next ring together?

.....  
(Total for Question E4 is 3 marks)



**HIGHER***Higher tier only*

**E5**  $A = 2^4 \times 3^2 \times 7$        $B = 2^3 \times 3^5 \times 5$

**(a)** Find the highest common factor (HCF) of  $A$  and  $B$ .

.....  
(2)

**(b)** Find the lowest common multiple (LCM) of  $A$  and  $B$ . Give your answer as a product of powers of prime factors.

.....  
(2)

**(Total for Question E5 is 4 marks)****E6** **(a)** Write 2200 as a product of powers of its prime factors. Show your working clearly.

.....  
(3)

**(b)** Find the smallest whole number that 2200 can be multiplied by to give a square number.

.....  
(2)

**(Total for Question E6 is 5 marks)**

**E7**  $A = 2^x \times 3^2 \times 5$        $B = 2^3 \times 3^y \times 7$

The HCF of  $A$  and  $B$  is  $2^3 \times 3$

The LCM of  $A$  and  $B$  is  $2^5 \times 3^2 \times 5 \times 7$

Find the value of  $x$  and the value of  $y$ .

$x = \dots\dots\dots$      $y = \dots\dots\dots$

(Total for Question E7 is 3 marks)

**E8** The HCF of  $n$  and 36 is 12

The LCM of  $n$  and 36 is 180

Find the value of  $n$ .

$n = \dots\dots\dots$

(Total for Question E8 is 3 marks)

**E9** Find the smallest whole number **greater than 1** that leaves a remainder of 1 when it is divided by 4, by 5 and by 6

$\dots\dots\dots$

(Total for Question E9 is 3 marks)

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