

Factors, Multiples and Primes: Quick Questions

Mini whiteboard questions, with solutions

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Factors

True or false?

7 is a factor of 21

True or false?

7 is a factor of 21

True. $21 = 7 \times 3$, so 21 divides exactly by 7.

True or false?

1 is a factor of every whole number

True or false?

1 is a factor of every whole number

True. Every number n can be written as $1 \times n$.

True or false?

6 is a factor of 16

True or false?

6 is a factor of 16

False. The factors of 16 are 1, 2, 4, 8, 16;

$16 \div 6$ is not a whole number.

True or false?

Every number has an even number of factors

True or false?

Every number has an even number of factors

False. Factors usually pair up, but 9 has just 1, 3, 9 — three factors — because 3×3 uses the same factor twice.

True or false?

If 4 is a factor of a number,
then 8 must be a factor of it too

True or false?

If 4 is a factor of a number,
then 8 must be a factor of it too

False. 4 is a factor of 12, but 8 is not.

List all the factors of 12

List all the factors of 12

1, 2, 3, 4, 6, 12

List all the factors of 20

List all the factors of 20

1, 2, 4, 5, 10, 20

List all the factors of 36

List all the factors of 36

1, 2, 3, 4, 6, 9, 12, 18, 36

How many factors does 16 have?

How many factors does 16 have?

1, 2, 4, 8, 16

Five factors.

Find the highest common factor of 12 and 18

Find the highest common factor of 12 and 18

Factors of 12: 1, 2, 3, 4, **6**, 12

Factors of 18: 1, 2, 3, **6**, 9, 18

$$\text{HCF} = 6$$

Find the highest common factor of 24 and 36

Find the highest common factor of 24 and 36

Factors of 24: 1, 2, 3, 4, 6, 8, **12**, 24

Factors of 36: 1, 2, 3, 4, 6, 9, **12**, 18, 36

$$\text{HCF} = 12$$

List all the factor pairs of 48

List all the factor pairs of 48

$$1 \times 48 \quad 2 \times 24 \quad 3 \times 16$$

$$4 \times 12 \quad 6 \times 8$$

Which whole number below 30 has the most factors?

Which whole number below 30 has the most factors?

24, with eight factors:

1, 2, 3, 4, 6, 8, 12, 24

n has exactly three factors.

Give a possible value of n .

n has exactly three factors.

Give a possible value of n .

4 (1, 2, 4), 9 (1, 3, 9) or 25 (1, 5, 25).

Any prime squared works.

Explain why square numbers have an odd number of factors

Explain why square numbers have an odd number of factors

Factors come in pairs, one either side of the square root.
In a square number the square root pairs with itself, so one factor is left unpaired.

Multiples

True or false?

24 is a multiple of 6

True or false?

24 is a multiple of 6

True. $6 \times 4 = 24.$

True or false?

Every multiple of 10 is also a multiple of 5

True or false?

Every multiple of 10 is also a multiple of 5

True. $10 = 5 \times 2$, so every multiple of 10 already contains a factor of 5.

True or false?

35 is a multiple of 4

True or false?

35 is a multiple of 4

False. $4 \times 8 = 32$ and $4 \times 9 = 36$, so 35 is stepped over.

True or false?

Every multiple of 3 is also a multiple of 9

True or false?

Every multiple of 3 is also a multiple of 9

False. 6 is a multiple of 3 but not of 9.

The other way round *is* true.

True or false?

The lowest common multiple of two numbers is always found by multiplying them together

True or false?

The lowest common multiple of two numbers is always found by multiplying them together

False. $4 \times 6 = 24$, but the LCM of 4 and 6 is 12.

Multiplying only works when the numbers share no factors.

Write down the first five multiples of 4

Write down the first five multiples of 4

4, 8, 12, 16, 20

Write down the first five multiples of 7

Write down the first five multiples of 7

7, 14, 21, 28, 35

Write down the multiples of 6 between 20 and 50

Write down the multiples of 6 between 20 and 50

24, 30, 36, 42, 48

Is 126 a multiple of 9?

Is 126 a multiple of 9?

Yes. $1 + 2 + 6 = 9$, and $9 \times 14 = 126$.

Find the lowest common multiple of 4 and 6

Find the lowest common multiple of 4 and 6

4, 8, **12**, 16, ...

6, **12**, 18, ...

LCM = 12

Find the lowest common multiple of 8 and 12

Find the lowest common multiple of 8 and 12

8, 16, **24**, 32, ...

12, **24**, 36, ...

LCM = 24

Find the lowest common multiple of 5, 6 and 9

Find the lowest common multiple of 5, 6 and 9

LCM of 5 and 6 is 30.

LCM of 30 and 9 is 90.

$$\text{LCM} = 90$$

A number is a multiple of both 4 and 10.
What is the smallest it could be?

A number is a multiple of both 4 and 10.

What is the smallest it could be?

20, the lowest common multiple of 4 and 10.

Two lighthouses flash together now.
One flashes every 12 seconds, the other every 18 seconds.
When do they next flash together?

Two lighthouses flash together now.
One flashes every 12 seconds, the other every 18 seconds.
When do they next flash together?

$$\text{LCM}(12, 18) = 36$$

In 36 seconds.

Find the smallest number above 1 that leaves a remainder of 1 when divided by 4, by 5 and by 6

Find the smallest number above 1 that leaves a remainder of 1 when divided by 4, by 5 and by 6

The number must be one more than a common multiple of 4, 5 and 6.

$\text{LCM}(4, 5, 6) = 60$, so the number is 61.

Primes

True or false?

1 is a prime number

True or false?

1 is a prime number

False. A prime has exactly two factors, but 1 has only one.

True or false?

2 is the only even prime number

True or false?

2 is the only even prime number

True. Every other even number has 2 as an extra factor, so it has more than two factors.

True or false?

51 is a prime number

True or false?

51 is a prime number

False. $51 = 3 \times 17$.

Its digits add to 6, so it divides by 3.

True or false?

There are infinitely many prime numbers

True or false?

There are infinitely many prime numbers

True. The primes never run out, although they do thin out as the numbers get larger.

True or false?

If a number ends in 3, it must be prime

True or false?

If a number ends in 3, it must be prime

False. $33 = 3 \times 11$ and $63 = 7 \times 9$.

Write down all the prime numbers between 1 and 10

Write down all the prime numbers between 1 and 10

2, 3, 5, 7

Write down all the prime numbers between 10 and 20

Write down all the prime numbers between 10 and 20

11, 13, 17, 19

Is 27 a prime number?

Explain your answer.

Is 27 a prime number?

Explain your answer.

No. $27 = 3 \times 9$, so it has more than two factors.

Write down the first prime number greater than 30

Write down the first prime number greater than 30

31

Is 91 a prime number?

Is 91 a prime number?

No. $91 = 7 \times 13$.

How many prime numbers are there between 20 and 40?

How many prime numbers are there between 20 and 40?

23, 29, 31, 37

Four of them.

Is 143 a prime number?

Is 143 a prime number?

No. $143 = 11 \times 13$.

Find two prime numbers that add up to 24

Find two prime numbers that add up to 24

$$5 + 19 \quad 7 + 17 \quad 11 + 13$$

To test whether 211 is prime,
which numbers do you need to divide by?
Is it prime?

To test whether 211 is prime,
which numbers do you need to divide by?

Is it prime?

Only the primes up to $\sqrt{211} \approx 14.5$:

2, 3, 5, 7, 11, 13

None of them divides 211, so 211 is prime.

Explain why $n^2 - 1$ can never be prime when $n > 2$

Explain why $n^2 - 1$ can never be prime when $n > 2$

$$n^2 - 1 = (n - 1)(n + 1)$$

When $n > 2$ both brackets are bigger than 1, so the number always has more than two factors.

Is it prime?

1

1

Factors of 1: 1

1 has only one factor. A prime number has exactly two different factors, 1 and itself, and for 1 those would be the same factor, so 1 is not a prime number.

2

2

Factors of 2: 1, 2

2 has exactly two factors, 1 and itself, so 2 is a prime number. It is the only even prime number, because every other even number has 2 as a third factor.

3

3

Factors of 3: 1, 3

3 has exactly two factors, 1 and itself, so 3 is a prime number.

4

4

Factors of 4: 1, 2, 4

4 has three factors, not two, so 4 is not a prime number.

5

5

Factors of 5: 1, 5

5 has exactly two factors, 1 and itself, so 5 is a prime number.

We only need to test 2 as a factor, because $3 \times 3 = 9$ is bigger than 5.

6

6

Factors of 6: 1, 2, 3, 6

6 has four factors, not two, so 6 is not a prime number.

7

7

Factors of 7: 1, 7

7 has exactly two factors, 1 and itself, so 7 is a prime number.

We only need to test 2 as a factor, because $3 \times 3 = 9$ is bigger than 7.

8

8

Factors of 8: 1, 2, 4, 8

8 has four factors, not two, so 8 is not a prime number.

9

9

Factors of 9: 1, 3, 9

9 has three factors, not two, so 9 is not a prime number.

10

10

Factors of 10: 1, 2, 5, 10

10 has four factors, not two, so 10 is not a prime number.

11

11

Factors of 11: 1, 11

11 has exactly two factors, 1 and itself, so 11 is a prime number.

We only need to test 2 and 3 as factors, because $5 \times 5 = 25$ is bigger than 11.

12

12

Factors of 12: 1, 2, 3, 4, 6, 12

12 has six factors, not two, so 12 is not a prime number.

13

13

Factors of 13: 1, 13

13 has exactly two factors, 1 and itself, so 13 is a prime number.

We only need to test 2 and 3 as factors, because $5 \times 5 = 25$ is bigger than 13.

14

14

Factors of 14: 1, 2, 7, 14

14 has four factors, not two, so 14 is not a prime number.

15

15

Factors of 15: 1, 3, 5, 15

15 has four factors, not two, so 15 is not a prime number.

16

16

Factors of 16: 1, 2, 4, 8, 16

16 has five factors, not two, so 16 is not a prime number.

17

17

Factors of 17: 1, 17

17 has exactly two factors, 1 and itself, so 17 is a prime number.

We only need to test 2 and 3 as factors, because $5 \times 5 = 25$ is bigger than 17.

18

18

Factors of 18: 1, 2, 3, 6, 9, 18

18 has six factors, not two, so 18 is not a prime number.

19

19

Factors of 19: 1, 19

19 has exactly two factors, 1 and itself, so 19 is a prime number.

We only need to test 2 and 3 as factors, because $5 \times 5 = 25$ is bigger than 19.

20

20

Factors of 20: 1, 2, 4, 5, 10, 20

20 has six factors, not two, so 20 is not a prime number.

21

21

Factors of 21: 1, 3, 7, 21

21 has four factors, not two, so 21 is not a prime number.

22

22

Factors of 22: 1, 2, 11, 22

22 has four factors, not two, so 22 is not a prime number.

23

23

Factors of 23: 1, 23

23 has exactly two factors, 1 and itself, so 23 is a prime number.

We only need to test 2 and 3 as factors, because $5 \times 5 = 25$ is bigger than 23.

24

24

Factors of 24: 1, 2, 3, 4, 6, 8, 12, 24

24 has eight factors, not two, so 24 is not a prime number.

25

25

Factors of 25: 1, 5, 25

25 has three factors, not two, so 25 is not a prime number.

26

26

Factors of 26: 1, 2, 13, 26

26 has four factors, not two, so 26 is not a prime number.

27

27

Factors of 27: 1, 3, 9, 27

27 has four factors, not two, so 27 is not a prime number.

28

28

Factors of 28: 1, 2, 4, 7, 14, 28

28 has six factors, not two, so 28 is not a prime number.

29

29

Factors of 29: 1, 29

29 has exactly two factors, 1 and itself, so 29 is a prime number.

We only need to test 2, 3 and 5 as factors, because $7 \times 7 = 49$ is bigger than 29.

30

30

Factors of 30: 1, 2, 3, 5, 6, 10, 15, 30

30 has eight factors, not two, so 30 is not a prime number.

31

31

Factors of 31: 1, 31

31 has exactly two factors, 1 and itself, so 31 is a prime number.

We only need to test 2, 3 and 5 as factors, because $7 \times 7 = 49$ is bigger than 31.

32

32

Factors of 32: 1, 2, 4, 8, 16, 32

32 has six factors, not two, so 32 is not a prime number.

33

33

Factors of 33: 1, 3, 11, 33

33 has four factors, not two, so 33 is not a prime number.

34

34

Factors of 34: 1, 2, 17, 34

34 has four factors, not two, so 34 is not a prime number.

35

35

Factors of 35: 1, 5, 7, 35

35 has four factors, not two, so 35 is not a prime number.

36

36

Factors of 36: 1, 2, 3, 4, 6, 9, 12, 18, 36

36 has nine factors, not two, so 36 is not a prime number.

37

37

Factors of 37: 1, 37

37 has exactly two factors, 1 and itself, so 37 is a prime number.

We only need to test 2, 3 and 5 as factors, because $7 \times 7 = 49$ is bigger than 37.

38

38

Factors of 38: 1, 2, 19, 38

38 has four factors, not two, so 38 is not a prime number.

39

39

Factors of 39: 1, 3, 13, 39

39 has four factors, not two, so 39 is not a prime number.

40

40

Factors of 40: 1, 2, 4, 5, 8, 10, 20, 40

40 has eight factors, not two, so 40 is not a prime number.

41

41

Factors of 41: 1, 41

41 has exactly two factors, 1 and itself, so 41 is a prime number.

We only need to test 2, 3 and 5 as factors, because $7 \times 7 = 49$ is bigger than 41.

42

42

Factors of 42: 1, 2, 3, 6, 7, 14, 21, 42

42 has eight factors, not two, so 42 is not a prime number.

43

43

Factors of 43: 1, 43

43 has exactly two factors, 1 and itself, so 43 is a prime number.

We only need to test 2, 3 and 5 as factors, because $7 \times 7 = 49$ is bigger than 43.

44

44

Factors of 44: 1, 2, 4, 11, 22, 44

44 has six factors, not two, so 44 is not a prime number.

45

45

Factors of 45: 1, 3, 5, 9, 15, 45

45 has six factors, not two, so 45 is not a prime number.

46

46

Factors of 46: 1, 2, 23, 46

46 has four factors, not two, so 46 is not a prime number.

47

47

Factors of 47: 1, 47

47 has exactly two factors, 1 and itself, so 47 is a prime number.

We only need to test 2, 3 and 5 as factors, because $7 \times 7 = 49$ is bigger than 47.

48

48

Factors of 48: 1, 2, 3, 4, 6, 8, 12, 16, 24, 48

48 has ten factors, not two, so 48 is not a prime number.

49

49

Factors of 49: 1, 7, 49

49 has three factors, not two, so 49 is not a prime number.

50

50

Factors of 50: 1, 2, 5, 10, 25, 50

50 has six factors, not two, so 50 is not a prime number.

51

51

Factors of 51: 1, 3, 17, 51

51 has four factors, not two, so 51 is not a prime number.

52

52

Factors of 52: 1, 2, 4, 13, 26, 52

52 has six factors, not two, so 52 is not a prime number.

53

53

Factors of 53: 1, 53

53 has exactly two factors, 1 and itself, so 53 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 53.

54

54

Factors of 54: 1, 2, 3, 6, 9, 18, 27, 54

54 has eight factors, not two, so 54 is not a prime number.

55

55

Factors of 55: 1, 5, 11, 55

55 has four factors, not two, so 55 is not a prime number.

56

56

Factors of 56: 1, 2, 4, 7, 8, 14, 28, 56

56 has eight factors, not two, so 56 is not a prime number.

57

57

Factors of 57: 1, 3, 19, 57

57 has four factors, not two, so 57 is not a prime number.

58

58

Factors of 58: 1, 2, 29, 58

58 has four factors, not two, so 58 is not a prime number.

59

59

Factors of 59: 1, 59

59 has exactly two factors, 1 and itself, so 59 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 59.

60

60

Factors of 60: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60

60 has twelve factors, not two, so 60 is not a prime number.

61

61

Factors of 61: 1, 61

61 has exactly two factors, 1 and itself, so 61 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 61.

62

62

Factors of 62: 1, 2, 31, 62

62 has four factors, not two, so 62 is not a prime number.

63

63

Factors of 63: 1, 3, 7, 9, 21, 63

63 has six factors, not two, so 63 is not a prime number.

64

64

Factors of 64: 1, 2, 4, 8, 16, 32, 64

64 has seven factors, not two, so 64 is not a prime number.

65

65

Factors of 65: 1, 5, 13, 65

65 has four factors, not two, so 65 is not a prime number.

66

66

Factors of 66: 1, 2, 3, 6, 11, 22, 33, 66

66 has eight factors, not two, so 66 is not a prime number.

67

67

Factors of 67: 1, 67

67 has exactly two factors, 1 and itself, so 67 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 67.

68

68

Factors of 68: 1, 2, 4, 17, 34, 68

68 has six factors, not two, so 68 is not a prime number.

69

69

Factors of 69: 1, 3, 23, 69

69 has four factors, not two, so 69 is not a prime number.

70

70

Factors of 70: 1, 2, 5, 7, 10, 14, 35, 70

70 has eight factors, not two, so 70 is not a prime number.

71

71

Factors of 71: 1, 71

71 has exactly two factors, 1 and itself, so 71 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 71.

72

72

Factors of 72: 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, 72

72 has twelve factors, not two, so 72 is not a prime number.

73

73

Factors of 73: 1, 73

73 has exactly two factors, 1 and itself, so 73 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 73.

74

74

Factors of 74: 1, 2, 37, 74

74 has four factors, not two, so 74 is not a prime number.

75

75

Factors of 75: 1, 3, 5, 15, 25, 75

75 has six factors, not two, so 75 is not a prime number.

76

76

Factors of 76: 1, 2, 4, 19, 38, 76

76 has six factors, not two, so 76 is not a prime number.

77

77

Factors of 77: 1, 7, 11, 77

77 has four factors, not two, so 77 is not a prime number.

78

78

Factors of 78: 1, 2, 3, 6, 13, 26, 39, 78

78 has eight factors, not two, so 78 is not a prime number.

79

79

Factors of 79: 1, 79

79 has exactly two factors, 1 and itself, so 79 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 79.

80

80

Factors of 80: 1, 2, 4, 5, 8, 10, 16, 20, 40, 80

80 has ten factors, not two, so 80 is not a prime number.

81

81

Factors of 81: 1, 3, 9, 27, 81

81 has five factors, not two, so 81 is not a prime number.

82

82

Factors of 82: 1, 2, 41, 82

82 has four factors, not two, so 82 is not a prime number.

83

83

Factors of 83: 1, 83

83 has exactly two factors, 1 and itself, so 83 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 83.

84

84

Factors of 84: 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84

84 has twelve factors, not two, so 84 is not a prime number.

85

85

Factors of 85: 1, 5, 17, 85

85 has four factors, not two, so 85 is not a prime number.

86

86

Factors of 86: 1, 2, 43, 86

86 has four factors, not two, so 86 is not a prime number.

87

87

Factors of 87: 1, 3, 29, 87

87 has four factors, not two, so 87 is not a prime number.

88

88

Factors of 88: 1, 2, 4, 8, 11, 22, 44, 88

88 has eight factors, not two, so 88 is not a prime number.

89

89

Factors of 89: 1, 89

89 has exactly two factors, 1 and itself, so 89 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 89.

90

90

Factors of 90: 1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90

90 has twelve factors, not two, so 90 is not a prime number.

91

91

Factors of 91: 1, 7, 13, 91

91 has four factors, not two, so 91 is not a prime number.

92

92

Factors of 92: 1, 2, 4, 23, 46, 92

92 has six factors, not two, so 92 is not a prime number.

93

93

Factors of 93: 1, 3, 31, 93

93 has four factors, not two, so 93 is not a prime number.

94

94

Factors of 94: 1, 2, 47, 94

94 has four factors, not two, so 94 is not a prime number.

95

95

Factors of 95: 1, 5, 19, 95

95 has four factors, not two, so 95 is not a prime number.

96

96

Factors of 96: 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96

96 has twelve factors, not two, so 96 is not a prime number.

97

97

Factors of 97: 1, 97

97 has exactly two factors, 1 and itself, so 97 is a prime number.

We only need to test 2, 3, 5 and 7 as factors, because $11 \times 11 = 121$ is bigger than 97.

98

98

Factors of 98: 1, 2, 7, 14, 49, 98

98 has six factors, not two, so 98 is not a prime number.

99

99

Factors of 99: 1, 3, 9, 11, 33, 99

99 has six factors, not two, so 99 is not a prime number.

100

100

Factors of 100: 1, 2, 4, 5, 10, 20, 25, 50, 100

100 has nine factors, not two, so 100 is not a prime number.

Prime factor decomposition

True or false?

$12 = 2^2 \times 3$ is the prime factor decomposition of 12

True or false?

$12 = 2^2 \times 3$ is the prime factor decomposition of 12

True. 2 and 3 are both prime, and $4 \times 3 = 12$.

True or false?

$2 \times 3 \times 4$ is the prime factor decomposition of 24

True or false?

$2 \times 3 \times 4$ is the prime factor decomposition of 24

False. 4 is not prime.

$$24 = 2^3 \times 3$$

True or false?

Every whole number greater than 1 can be written as a product of primes

True or false?

Every whole number greater than 1 can be written as a product of primes

True. A prime is its own decomposition, and any other number keeps splitting until only primes are left.

True or false?

A number can have two different prime factor decompositions

True or false?

A number can have two different prime factor decompositions

False. Apart from the order you write them in, every number has exactly one decomposition.

True or false?

$$2^3 \times 5 = 30$$

True or false?

$$2^3 \times 5 = 30$$

False. $2^3 \times 5 = 8 \times 5 = 40.$

$$30 = 2 \times 3 \times 5$$

Write 12 as a product of its prime factors

Write 12 as a product of its prime factors

$$12 = 2 \times 2 \times 3 = 2^2 \times 3$$

Write 18 as a product of its prime factors

Write 18 as a product of its prime factors

$$18 = 2 \times 3 \times 3 = 2 \times 3^2$$

Write 60 as a product of its prime factors

Write 60 as a product of its prime factors

$$60 = 2 \times 2 \times 3 \times 5 = 2^2 \times 3 \times 5$$

Write 84 as a product of its prime factors

Write 84 as a product of its prime factors

$$84 = 2 \times 2 \times 3 \times 7 = 2^2 \times 3 \times 7$$

Write 200 as a product of its prime factors

Write 200 as a product of its prime factors

$$200 = 2 \times 2 \times 2 \times 5 \times 5 = 2^3 \times 5^2$$

Write 360 as a product of its prime factors

Write 360 as a product of its prime factors

$$360 = 2^3 \times 3^2 \times 5$$

Write 1001 as a product of its prime factors

Write 1001 as a product of its prime factors

$$1001 = 7 \times 143 = 7 \times 11 \times 13$$

Work out $2^3 \times 3 \times 5^2$ as an ordinary number

Work out $2^3 \times 3 \times 5^2$ as an ordinary number

$$8 \times 3 \times 25 = 600$$

$$n = 2^3 \times 3 \times 5.$$

Write $2n$ as a product of prime factors.

$$n = 2^3 \times 3 \times 5.$$

Write $2n$ as a product of prime factors.

Doubling adds one more factor of 2:

$$2n = 2^4 \times 3 \times 5$$

$$720 = 2^4 \times 3^2 \times 5.$$

How many factors does 720 have?

$$720 = 2^4 \times 3^2 \times 5.$$

How many factors does 720 have?

Each factor uses 0 to 4 twos, 0 to 2 threes and 0 or 1 five:

$$5 \times 3 \times 2 = 30 \text{ factors}$$

HCF and LCM from lists

Find the HCF and LCM of 4 and 6.

Find the HCF and LCM of 4 and 6.

Factors of 4:

1, 2, 4

Factors of 6:

1, 2, 3, 6

Find the HCF and LCM of 4 and 6.

Factors of 4:

1, 2, 4

Factors of 6:

1, 2, 3, 6

Multiples of 4:

4, 8, 12, 16, 20,

24, 28, 32, 36, 40

Multiples of 6:

6, 12, 18, 24, 30,

36, 42, 48, 54, 60

Find the HCF and LCM of 4 and 6.

Factors of 4:

1, ②, 4

Factors of 6:

1, ②, 3, 6

Multiples of 4:

4, 8, 12, 16, 20,

24, 28, 32, 36, 40

Multiples of 6:

6, 12, 18, 24, 30,

36, 42, 48, 54, 60

Find the HCF and LCM of 4 and 6.

Factors of 4:

1, ②, 4

Factors of 6:

1, ②, 3, 6

Multiples of 4:

4, 8, ⑫, 16, 20,

24, 28, 32, 36, 40

Multiples of 6:

6, ⑫, 18, 24, 30,

36, 42, 48, 54, 60

Find the HCF and LCM of 6 and 8.

Find the HCF and LCM of 6 and 8.

Factors of 6:

1, 2, 3, 6

Factors of 8:

1, 2, 4, 8

Find the HCF and LCM of 6 and 8.

Factors of 6:

1, 2, 3, 6

Factors of 8:

1, 2, 4, 8

Multiples of 6:

6, 12, 18, 24, 30,

36, 42, 48, 54, 60

Multiples of 8:

8, 16, 24, 32, 40,

48, 56, 64, 72, 80

Find the HCF and LCM of 6 and 8.

Factors of 6:

1, ②, 3, 6

Factors of 8:

1, ②, 4, 8

Multiples of 6:

6, 12, 18, 24, 30,

36, 42, 48, 54, 60

Multiples of 8:

8, 16, 24, 32, 40,

48, 56, 64, 72, 80

Find the HCF and LCM of 6 and 8.

Factors of 6:

1, ②, 3, 6

Factors of 8:

1, ②, 4, 8

Multiples of 6:

6, 12, 18, ②4, 30,
36, 42, 48, 54, 60

Multiples of 8:

8, 16, ②4, 32, 40,
48, 56, 64, 72, 80

Find the HCF and LCM of 6 and 9.

Find the HCF and LCM of 6 and 9.

Factors of 6:

1, 2, 3, 6

Factors of 9:

1, 3, 9

Find the HCF and LCM of 6 and 9.

Factors of 6:

1, 2, 3, 6

Factors of 9:

1, 3, 9

Multiples of 6:

6, 12, 18, 24, 30,

36, 42, 48, 54, 60

Multiples of 9:

9, 18, 27, 36, 45,

54, 63, 72, 81, 90

Find the HCF and LCM of 6 and 9.

Factors of 6:

1, 2, ③, 6

Factors of 9:

1, ③, 9

Multiples of 6:

6, 12, 18, 24, 30,

36, 42, 48, 54, 60

Multiples of 9:

9, 18, 27, 36, 45,

54, 63, 72, 81, 90

Find the HCF and LCM of 6 and 9.

Factors of 6:

1, 2, ③, 6

Factors of 9:

1, ③, 9

Multiples of 6:

6, 12, ①8, 24, 30,

36, 42, 48, 54, 60

Multiples of 9:

9, ①8, 27, 36, 45,

54, 63, 72, 81, 90

Find the HCF and LCM of 8 and 12.

Find the HCF and LCM of 8 and 12.

Factors of 8:

1, 2, 4, 8

Factors of 12:

1, 2, 3, 4, 6, 12

Find the HCF and LCM of 8 and 12.

Factors of 8:

1, 2, 4, 8

Factors of 12:

1, 2, 3, 4, 6, 12

Multiples of 8:

8, 16, 24, 32, 40,

48, 56, 64, 72, 80

Multiples of 12:

12, 24, 36, 48, 60,

72, 84, 96, 108, 120

Find the HCF and LCM of 8 and 12.

Factors of 8:

1, 2, ④, 8

Factors of 12:

1, 2, 3, ④, 6, 12

Multiples of 8:

8, 16, 24, 32, 40,

48, 56, 64, 72, 80

Multiples of 12:

12, 24, 36, 48, 60,

72, 84, 96, 108, 120

Find the HCF and LCM of 8 and 12.

Factors of 8:

1, 2, ④, 8

Factors of 12:

1, 2, 3, ④, 6, 12

Multiples of 8:

8, 16, ②④, 32, 40,

48, 56, 64, 72, 80

Multiples of 12:

12, ②④, 36, 48, 60,

72, 84, 96, 108, 120

Find the HCF and LCM of 10 and 15.

Find the HCF and LCM of 10 and 15.

Factors of 10:

1, 2, 5, 10

Factors of 15:

1, 3, 5, 15

Find the HCF and LCM of 10 and 15.

Factors of 10:

1, 2, 5, 10

Factors of 15:

1, 3, 5, 15

Multiples of 10:

10, 20, 30, 40, 50,

60, 70, 80, 90, 100

Multiples of 15:

15, 30, 45, 60, 75,

90, 105, 120, 135, 150

Find the HCF and LCM of 10 and 15.

Factors of 10:

1, 2, ⑤, 10

Factors of 15:

1, 3, ⑤, 15

Multiples of 10:

10, 20, 30, 40, 50,

60, 70, 80, 90, 100

Multiples of 15:

15, 30, 45, 60, 75,

90, 105, 120, 135, 150

Find the HCF and LCM of 10 and 15.

Factors of 10:

1, 2, ⑤, 10

Factors of 15:

1, 3, ⑤, 15

Multiples of 10:

10, 20, ③0, 40, 50,

60, 70, 80, 90, 100

Multiples of 15:

15, ③0, 45, 60, 75,

90, 105, 120, 135, 150

Find the HCF and LCM of 9 and 12.

Find the HCF and LCM of 9 and 12.

Factors of 9:

1, 3, 9

Factors of 12:

1, 2, 3, 4, 6, 12

Find the HCF and LCM of 9 and 12.

Factors of 9:

1, 3, 9

Factors of 12:

1, 2, 3, 4, 6, 12

Multiples of 9:

9, 18, 27, 36, 45,

54, 63, 72, 81, 90

Multiples of 12:

12, 24, 36, 48, 60,

72, 84, 96, 108, 120

Find the HCF and LCM of 9 and 12.

Factors of 9:

1, ③, 9

Factors of 12:

1, 2, ③, 4, 6, 12

Multiples of 9:

9, 18, 27, 36, 45,

54, 63, 72, 81, 90

Multiples of 12:

12, 24, 36, 48, 60,

72, 84, 96, 108, 120

Find the HCF and LCM of 9 and 12.

Factors of 9:

1, ③, 9

Factors of 12:

1, 2, ③, 4, 6, 12

Multiples of 9:

9, 18, 27, ③⑥, 45,

54, 63, 72, 81, 90

Multiples of 12:

12, 24, ③⑥, 48, 60,

72, 84, 96, 108, 120

Find the HCF and LCM of 12 and 18.

Find the HCF and LCM of 12 and 18.

Factors of 12:

1, 2, 3, 4, 6, 12

Factors of 18:

1, 2, 3, 6, 9, 18

Find the HCF and LCM of 12 and 18.

Factors of 12:

1, 2, 3, 4, 6, 12

Factors of 18:

1, 2, 3, 6, 9, 18

Multiples of 12:

12, 24, 36, 48, 60,

72, 84, 96, 108, 120

Multiples of 18:

18, 36, 54, 72, 90,

108, 126, 144, 162, 180

Find the HCF and LCM of 12 and 18.

Factors of 12:

1, 2, 3, 4, ⑥, 12

Factors of 18:

1, 2, 3, ⑥, 9, 18

Multiples of 12:

12, 24, 36, 48, 60,

72, 84, 96, 108, 120

Multiples of 18:

18, 36, 54, 72, 90,

108, 126, 144, 162, 180

Find the HCF and LCM of 12 and 18.

Factors of 12:

1, 2, 3, 4, ⑥, 12

Factors of 18:

1, 2, 3, ⑥, 9, 18

Multiples of 12:

12, 24, ③⑥, 48, 60,

72, 84, 96, 108, 120

Multiples of 18:

18, ③⑥, 54, 72, 90,

108, 126, 144, 162, 180

Find the HCF and LCM of 14 and 21.

Find the HCF and LCM of 14 and 21.

Factors of 14:

1, 2, 7, 14

Factors of 21:

1, 3, 7, 21

Find the HCF and LCM of 14 and 21.

Factors of 14:

1, 2, 7, 14

Factors of 21:

1, 3, 7, 21

Multiples of 14:

14, 28, 42, 56, 70,

84, 98, 112, 126, 140

Multiples of 21:

21, 42, 63, 84, 105,

126, 147, 168, 189, 210

Find the HCF and LCM of 14 and 21.

Factors of 14:

1, 2, 7, 14

Factors of 21:

1, 3, 7, 21

Multiples of 14:

14, 28, 42, 56, 70,

84, 98, 112, 126, 140

Multiples of 21:

21, 42, 63, 84, 105,

126, 147, 168, 189, 210

Find the HCF and LCM of 14 and 21.

Factors of 14:

1, 2, 7, 14

Factors of 21:

1, 3, 7, 21

Multiples of 14:

14, 28, 42, 56, 70,

84, 98, 112, 126, 140

Multiples of 21:

21, 42, 63, 84, 105,

126, 147, 168, 189, 210

Find the HCF and LCM of 15 and 20.

Find the HCF and LCM of 15 and 20.

Factors of 15:

1, 3, 5, 15

Factors of 20:

1, 2, 4, 5, 10, 20

Find the HCF and LCM of 15 and 20.

Factors of 15:

1, 3, 5, 15

Factors of 20:

1, 2, 4, 5, 10, 20

Multiples of 15:

15, 30, 45, 60, 75,

90, 105, 120, 135, 150

Multiples of 20:

20, 40, 60, 80, 100,

120, 140, 160, 180, 200

Find the HCF and LCM of 15 and 20.

Factors of 15:

1, 3, ⑤, 15

Factors of 20:

1, 2, 4, ⑤, 10, 20

Multiples of 15:

15, 30, 45, 60, 75,

90, 105, 120, 135, 150

Multiples of 20:

20, 40, 60, 80, 100,

120, 140, 160, 180, 200

Find the HCF and LCM of 15 and 20.

Factors of 15:

1, 3, ⑤, 15

Factors of 20:

1, 2, 4, ⑤, 10, 20

Multiples of 15:

15, 30, 45, ⑥0, 75,

90, 105, 120, 135, 150

Multiples of 20:

20, 40, ⑥0, 80, 100,

120, 140, 160, 180, 200

Find the HCF and LCM of 8 and 9.

Find the HCF and LCM of 8 and 9.

Factors of 8:

1, 2, 4, 8

Factors of 9:

1, 3, 9

Find the HCF and LCM of 8 and 9.

Factors of 8:

1, 2, 4, 8

Factors of 9:

1, 3, 9

Multiples of 8:

8, 16, 24, 32, 40,
48, 56, 64, 72, 80

Multiples of 9:

9, 18, 27, 36, 45,
54, 63, 72, 81, 90

Find the HCF and LCM of 8 and 9.

Factors of 8:

①, 2, 4, 8

Factors of 9:

①, 3, 9

Multiples of 8:

8, 16, 24, 32, 40,
48, 56, 64, 72, 80

Multiples of 9:

9, 18, 27, 36, 45,
54, 63, 72, 81, 90

Find the HCF and LCM of 8 and 9.

Factors of 8:

①, 2, 4, 8

Factors of 9:

①, 3, 9

Multiples of 8:

8, 16, 24, 32, 40,
48, 56, 64, ⑦2 80

Multiples of 9:

9, 18, 27, 36, 45,
54, 63, ⑦2 81, 90

HCF and LCM by prime factor decomposition

True or false?

The HCF of two numbers is always smaller than both of them

True or false?

The HCF of two numbers is always smaller than both of them

False. The HCF of 6 and 12 is 6, which is one of the numbers itself.

True or false?

The LCM of two numbers is always a multiple of both of them

True or false?

The LCM of two numbers is always a multiple of both of them

True. That is exactly what a common multiple is; the LCM is the smallest one.

True or false?

If $a = 2^2 \times 3$ and $b = 2 \times 3^2$,
then the HCF of a and b is 2×3

True or false?

If $a = 2^2 \times 3$ and $b = 2 \times 3^2$,
then the HCF of a and b is 2×3

True. Take the *lowest* power of each prime that appears in
both: $2^1 \times 3^1 = 6$.

True or false?

HCF $\times$ LCM gives the product of the two numbers

True or false?

$\text{HCF} \times \text{LCM}$ gives the product of the two numbers

True. Every prime is counted once at its lowest power and once at its highest, which is the same as counting both numbers.

True or false?

The lowest common multiple of 6 and 8 is 48

True or false?

The lowest common multiple of 6 and 8 is 48

False. $6 = 2 \times 3$ and $8 = 2^3$, so the LCM is $2^3 \times 3 = 24$.

$$12 = 2^2 \times 3 \quad \text{and} \quad 18 = 2 \times 3^2$$

Find the HCF of 12 and 18.

$$12 = 2^2 \times 3 \quad \text{and} \quad 18 = 2 \times 3^2$$

Find the HCF of 12 and 18.

Lowest power of each shared prime:

$$\text{HCF} = 2 \times 3 = 6$$

$$12 = 2^2 \times 3 \quad \text{and} \quad 18 = 2 \times 3^2$$

Find the LCM of 12 and 18.

$$12 = 2^2 \times 3 \quad \text{and} \quad 18 = 2 \times 3^2$$

Find the LCM of 12 and 18.

Highest power of each prime:

$$\text{LCM} = 2^2 \times 3^2 = 36$$

$$24 = 2^3 \times 3 \quad \text{and} \quad 60 = 2^2 \times 3 \times 5$$

Find the HCF of 24 and 60.

$$24 = 2^3 \times 3 \quad \text{and} \quad 60 = 2^2 \times 3 \times 5$$

Find the HCF of 24 and 60.

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

$$24 = 2^3 \times 3 \quad \text{and} \quad 60 = 2^2 \times 3 \times 5$$

Find the LCM of 24 and 60.

$$24 = 2^3 \times 3 \quad \text{and} \quad 60 = 2^2 \times 3 \times 5$$

Find the LCM of 24 and 60.

$$\text{LCM} = 2^3 \times 3 \times 5 = 120$$

Find the HCF and the LCM of 84 and 120

Find the HCF and the LCM of 84 and 120

$$84 = 2^2 \times 3 \times 7 \quad 120 = 2^3 \times 3 \times 5$$

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

$$\text{LCM} = 2^3 \times 3 \times 5 \times 7 = 840$$

Find the HCF and the LCM of 126 and 180

Find the HCF and the LCM of 126 and 180

$$126 = 2 \times 3^2 \times 7 \quad 180 = 2^2 \times 3^2 \times 5$$

$$\text{HCF} = 2 \times 3^2 = 18$$

$$\text{LCM} = 2^2 \times 3^2 \times 5 \times 7 = 1260$$

$$a = 2^3 \times 3^2 \times 5 \quad \text{and} \quad b = 2^2 \times 3 \times 5^2$$

Find the HCF and the LCM, in index form.

$$a = 2^3 \times 3^2 \times 5 \quad \text{and} \quad b = 2^2 \times 3 \times 5^2$$

Find the HCF and the LCM, in index form.

$$\text{HCF} = 2^2 \times 3 \times 5$$

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

Two numbers have HCF 6 and LCM 72.
One of the numbers is 24. Find the other.

Two numbers have HCF 6 and LCM 72.
One of the numbers is 24. Find the other.

$\text{HCF} \times \text{LCM} = 6 \times 72 = 432$, which is the product of the two numbers.

$$432 \div 24 = 18$$

Find the HCF and the LCM of
 $2^5 \times 3^2 \times 11$ and $2^3 \times 3^4 \times 7$
Leave your answers in index form.

Find the HCF and the LCM of
 $2^5 \times 3^2 \times 11$ and $2^3 \times 3^4 \times 7$
Leave your answers in index form.

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

$$\text{LCM} = 2^5 \times 3^4 \times 7 \times 11$$

Two numbers have HCF 12 and LCM 180.
Find the numbers. Is there more than one answer?

Two numbers have HCF 12 and LCM 180.

Find the numbers. Is there more than one answer?

Their product is $12 \times 180 = 2160$, and both are multiples of 12.

12 and 180 or 36 and 60

Both pairs work, so there is more than one answer.

Square numbers from prime factors

True or false?

A number is square exactly when every power in its prime factor decomposition is even

True or false?

A number is square exactly when every power in its prime factor decomposition is even

True. Halving every even power gives the square root.

True or false?

$2^3 \times 3^2$ is a square number

True or false?

$2^3 \times 3^2$ is a square number

False. The power of 2 is odd, so the number cannot be split into two equal halves.

True or false?

$2^4 \times 5^6$ is a square number

True or false?

$2^4 \times 5^6$ is a square number

True. $2^4 \times 5^6 = (2^2 \times 5^3)^2$

True or false?

Every square number has an even number of factors

True or false?

Every square number has an even number of factors

False. Square numbers have an *odd* number of factors:

16 has 1, 2, 4, 8, 16.

True or false?

If n is a square number, then $4n$ is a square number too

True or false?

If n is a square number, then $4n$ is a square number too

True. Multiplying by $4 = 2^2$ keeps every power even.

Use prime factors to show that 36 is a square number

Use prime factors to show that 36 is a square number

$$36 = 2^2 \times 3^2$$

Both powers are even, and $36 = (2 \times 3)^2 = 6^2$.

Is $2^2 \times 3^2 \times 5^2$ a square number?

If so, what is its square root?

Is $2^2 \times 3^2 \times 5^2$ a square number?

If so, what is its square root?

Yes — every power is even.

$$\sqrt{2^2 \times 3^2 \times 5^2} = 2 \times 3 \times 5 = 30$$

Is $2^3 \times 3^2$ a square number?

Is $2^3 \times 3^2$ a square number?

No. Halving the powers would need $2^{1.5}$,
so the power of 2 must be even and it is not.

Work out $\sqrt{2^6 \times 3^4}$

Work out $\sqrt{2^6 \times 3^4}$

Halve each power:

$$2^3 \times 3^2 = 8 \times 9 = 72$$

Use prime factors to decide whether 400 is a square number

Use prime factors to decide whether 400 is a square number

$$400 = 2^4 \times 5^2$$

Both powers are even, so $400 = (2^2 \times 5)^2 = 20^2$.

Use prime factors to decide whether 150 is a square number

Use prime factors to decide whether 150 is a square number

$$150 = 2 \times 3 \times 5^2$$

The powers of 2 and 3 are odd, so 150 is not square.

Work out $\sqrt{2^8 \times 3^2 \times 5^4}$

Work out $\sqrt{2^8 \times 3^2 \times 5^4}$

Halve each power:

$$2^4 \times 3 \times 5^2 = 16 \times 3 \times 25 = 1200$$

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

Find the smallest whole number k so that nk is a square number.

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

Find the smallest whole number k so that nk is a square number.

The powers of 2 and 3 are odd, so each needs one more:

$$k = 2 \times 3 = 6, \text{ giving } nk = 2^4 \times 3^2 \times 5^2.$$

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

Find the smallest number 504 can be multiplied by to give a square number.

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

Find the smallest number 504 can be multiplied by to give a square number.

The powers of 2 and 7 are odd:
multiply by $2 \times 7 = 14$.

$$504 \times 14 = 7056 = 84^2$$

$$1080 = 2^3 \times 3^3 \times 5$$

Find the smallest number 1080 can be divided by to give a square number.

$$1080 = 2^3 \times 3^3 \times 5$$

Find the smallest number 1080 can be divided by to give a square number.

Remove one 2, one 3 and the 5:

divide by $2 \times 3 \times 5 = 30$.

$$1080 \div 30 = 36 = 6^2$$

Problem solving with HCF and LCM

True or false?

To find when two repeating events next happen together, you use the LCM

True or false?

To find when two repeating events next happen together, you use the LCM

True. You are looking for the first time that is a multiple of both gaps.

True or false?

To split two collections into the largest identical bags, you use the LCM

True or false?

To split two collections into the largest identical bags, you use the LCM

False. Use the HCF — the bag size has to be a factor of both amounts.

True or false?

Cutting two ropes into equal pieces, as long as possible with none left over, uses the HCF

True or false?

Cutting two ropes into equal pieces, as long as possible with none left over, uses the HCF

True. The piece length must be a factor of both rope lengths.

True or false?

The LCM of two numbers is never smaller than either of them

True or false?

The LCM of two numbers is never smaller than either of them

True. It is a multiple of each number, so it is at least as big as both.

True or false?

Two events repeat every 4 minutes and every 6 minutes,
so they coincide every 24 minutes

True or false?

Two events repeat every 4 minutes and every 6 minutes,
so they coincide every 24 minutes

False. They coincide every $\text{LCM}(4, 6) = 12$ minutes.

Two bells ring together now.
One rings every 4 minutes, the other every 6 minutes.
When do they next ring together?

Two bells ring together now.

One rings every 4 minutes, the other every 6 minutes.

When do they next ring together?

Common multiple, so use the LCM:

$\text{LCM}(4, 6) = 12$ — in 12 minutes.

Two ribbons, 18 cm and 24 cm long, are cut into equal pieces,
as long as possible with none left over.

How long is each piece?

Two ribbons, 18 cm and 24 cm long, are cut into equal pieces,
as long as possible with none left over.

How long is each piece?

The length must be a factor of both, so use the HCF:

$\text{HCF}(18, 24) = 6$ — each piece is 6 cm.

36 pens and 48 pencils are shared into identical packs with nothing left over.

What is the greatest number of packs?

36 pens and 48 pencils are shared into identical packs with nothing left over.

What is the greatest number of packs?

$$36 = 2^2 \times 3^2 \qquad 48 = 2^4 \times 3$$

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

each with 3 pens and 4 pencils.

Two lighthouses flash together at 8pm.
One flashes every 15 seconds, the other every 18 seconds.
When do they next flash together?

Two lighthouses flash together at 8pm.
One flashes every 15 seconds, the other every 18 seconds.
When do they next flash together?

$$\text{LCM}(15, 18) = 90 \text{ seconds}$$

At 8:01:30pm.

Rectangular tiles measure 12 cm by 18 cm.
What is the smallest square they can tile exactly?

Rectangular tiles measure 12 cm by 18 cm.

What is the smallest square they can tile exactly?

The side must be a multiple of both, so use the LCM:

$$\text{LCM}(12, 18) = 36$$

A 36 cm by 36 cm square.

A bus leaves every 24 minutes and a tram every 36 minutes.
Both leave at 9:00. When do they next leave together?

A bus leaves every 24 minutes and a tram every 36 minutes.
Both leave at 9:00. When do they next leave together?

$$\text{LCM}(24, 36) = 72 \text{ minutes}$$

At 10:12.

Two cogs, with 18 and 24 teeth, start meshed at a marked tooth.

How many turns does each make before the marks meet again?

Two cogs, with 18 and 24 teeth, start meshed at a marked tooth.

How many turns does each make before the marks meet again?

$\text{LCM}(18, 24) = 72$ teeth must pass.

$72 \div 18 = 4$ turns of the small cog,

$72 \div 24 = 3$ turns of the large cog.

A floor measures 360 cm by 504 cm.
It is tiled with identical square tiles, as large as possible.
Find the tile size and the number of tiles.

A floor measures 360 cm by 504 cm.

It is tiled with identical square tiles, as large as possible.

Find the tile size and the number of tiles.

$$360 = 2^3 \times 3^2 \times 5 \qquad 504 = 2^3 \times 3^2 \times 7$$

$\text{HCF} = 2^3 \times 3^2 = 72$, so the tiles are 72 cm square.

$$5 \times 7 = 35 \text{ tiles.}$$

Three runners take 60 s, 72 s and 90 s per lap.
They start together. When are they next all at the start line?

Three runners take 60 s, 72 s and 90 s per lap.

They start together. When are they next all at the start line?

$$60 = 2^2 \times 3 \times 5 \quad 72 = 2^3 \times 3^2 \quad 90 = 2 \times 3^2 \times 5$$

$$\text{LCM} = 2^3 \times 3^2 \times 5 = 360 \text{ s}$$

After 6 minutes.

Hot dogs come in packs of 10, buns in packs of 8 and sauce sachets in packs of 12.

What is the smallest number of complete hot dogs Sam can make with nothing left over, and how many packs of each is that?

Hot dogs come in packs of 10, buns in packs of 8 and sauce sachets in packs of 12.

What is the smallest number of complete hot dogs Sam can make with nothing left over, and how many packs of each is that?

$$\text{LCM}(10, 8, 12) = 2^3 \times 3 \times 5 = 120$$

120 hot dogs: 12 packs of hot dogs,
15 packs of buns and 10 packs of sachets.