## Section B

**B1**

$$1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, \ldots$$

If the pattern continues, what is the sum of the first 30 numbers?

**Solution.** The pattern is repeating. The repeating unit is $1, 2, 3, 4$ and the period is 4. The first 28 numbers, then, are 7 copies of this repeating unit. So the first 28 numbers sum to $(1 + 2 + 3 + 4) \times 7$. The last two numbers are 1 and 2.

So we calculate:

$$(1 + 2 + 3 + 4) \times 7 + 1 + 2 = 10 \times 7 + 1 + 2 = 70 + 1 + 2 = 73$$

Answer to B1: 73

**B2**
In simplest form, what is $\frac{2}{5} - \frac{1}{15}$?

**Solution.** We must promote the fractions to a common denominator. 15 is the least common multiple of 5 and 15, so we can use that. Then

$$\frac{2}{5} = \frac{2 \times 3}{5 \times 3} = \frac{6}{15}$$

and hence

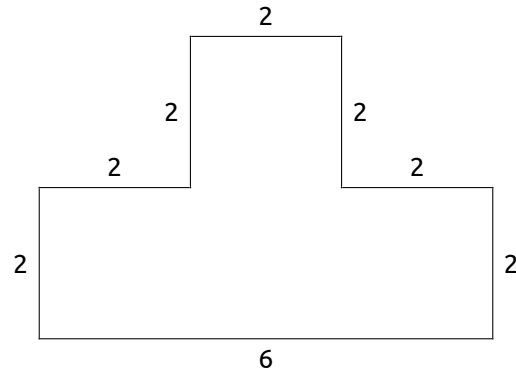$$\frac{2}{5} - \frac{1}{15} = \frac{6}{15} - \frac{1}{15} = \frac{5}{15}$$

which we can simplify to

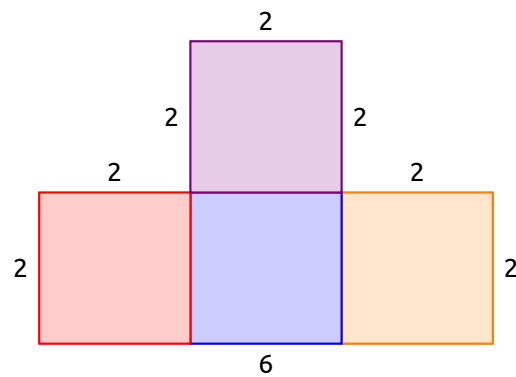$$\frac{5}{15} = \frac{5 \div 5}{15 \div 5} = \frac{1}{3}$$

Answer to B2: $\frac{1}{3}$

**B3**
Find the area of the shape below:

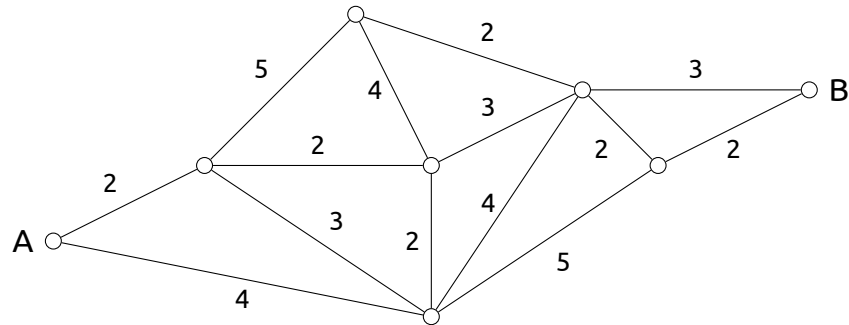**Solution.** We can split this shape into four squares:



Each square has area $2^2 = 2 \times 2 = 4$, so the total area is
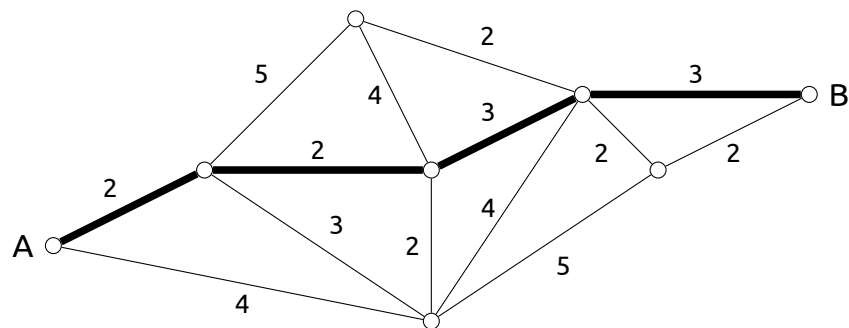
$$4 \times 4 = 16$$

Answer to B3: 16

**B4**
The picture below shows a map of several cities and the lengths of the roads connecting them. What is the length of the shortest path from city A to city B?

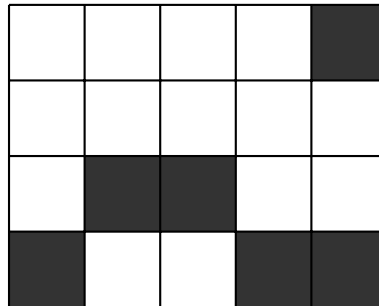**Solution.** The shortest path is drawn in bold below:



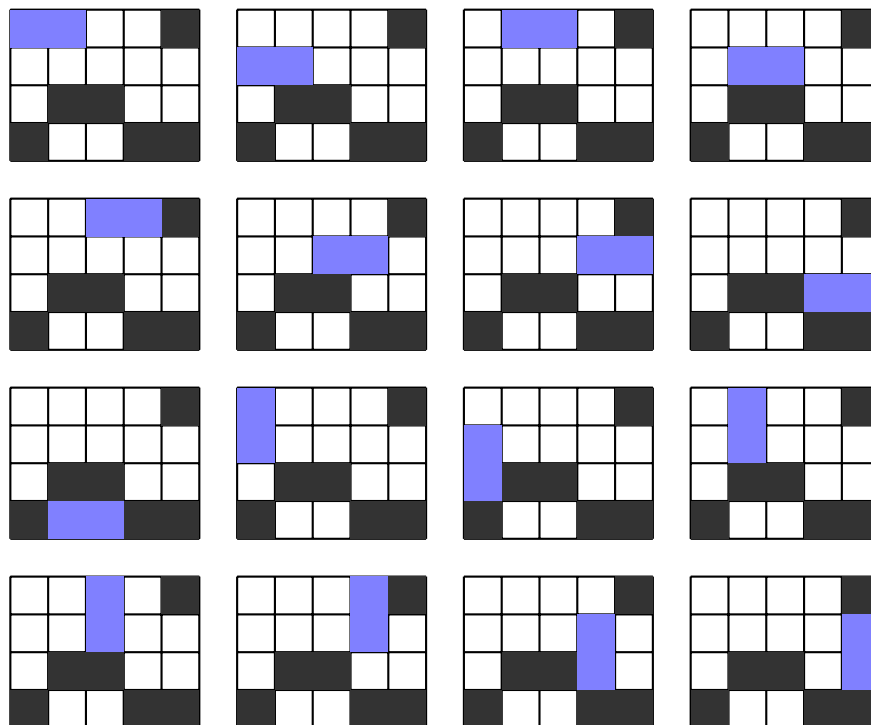The length of this path is

$$2 + 2 + 3 + 3 = 10$$

Answer to B4: 10

**B5**
In how many different positions can a domino be placed on the grid below without over-lapping any of the shaded squares?

**Solution.** All 16 possible domino placements are enumerated in the diagram below.



Answer to B5: 16

**B6**
Tanya is training for a marathon. She runs 10 km each day from Monday to Friday and 20 km each day during the weekend. If Tanya starts training on a Monday, how many days will it take her to run a total of 500 km?

**Solution.** In 7 days, she will have run

$$5 \times 10\,\text{km} + 2 \times 20\,\text{km} = 90\,\text{km}$$

so it should take her at least

$$500\,\text{km} \div 90\,\text{km} = 5$$

full weeks. But

$$90\,\text{km} \times 5 = 450\,\text{km}$$

is 50 km too short, so she needs to run for five more days, Monday to Friday, to reach 500 km. In total she runs for

$$7 \times 5 + 5 = 35 + 5 = 40$$

days.

<div align="right">Answer to B6: 40</div>

**B7**
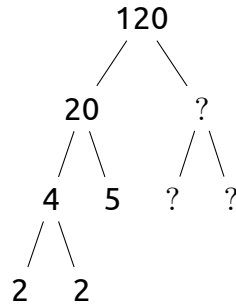There are 4 people in total. How many ways can you arrange them in a row to take a photo?

**Solution.** We could name the people A, B, C, and D, and list all 24 ways to arrange them:

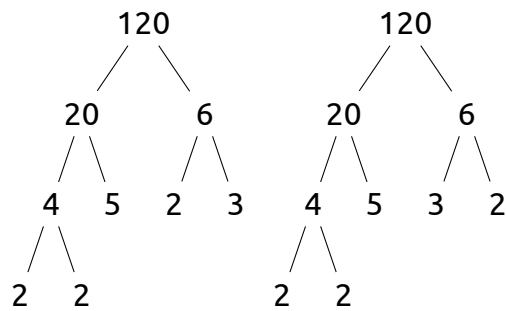| | | | | | |
|---|---|---|---|---|---|
| ABCD | ABDC | ACBD | ACDB | ADBC | ADCB |
| BACD | BADC | BCAD | BCDA | BDAC | BDCA |
| CABD | CADB | CBAD | CBDA | CDAB | CDBA |
| DABC | DACB | DBAC | DBCA | DCAB | DCBA |

<div align="right">Answer to B7: 24</div>

**B8**
Each node in the tree below has either two or no children. (Children are drawn below their parent are are connected by a line.) Each node is labelled with a positive whole number. Each label is the product of the labels of both its children. No label is 1. Find the sum of the three missing numbers, which are each marked by question marks (?).

```
                        120
                       /    \
                    20        ?
                   /  \      / \
                  4    5    ?   ?
                 / \
                2   2
```

**Solution.** There are two ways to fill out the missing numbers:

```
        120                      120
       /   \                    /   \
     20     6                 20      6
    /  \   / \               /  \    / \
   4    5 2   3             4    5  3   2
  / \                      / \
 2   2                    2   2
```

Either way, the sum of missing numbers does not change; it must be

$$6 + 3 + 2 = 11$$

Answer to B8: 11