Exercises 4

1. Using dictionary comprehension on the following list, create a dictionary that maps the Welsh town to the number of characters in its name:

```
>>> welsh_towns = [
...     'Llanfair-ym-Muallt',
...     'Caernarfon',
...     'Castell Newydd Emlyn',
...     'Penarth',
...     'Aberdyfi',
...     'Llanon',
...     'Rhydyfelin',
...     'Llantrisant',
...     'Borth',
...     'Rhyl',
...     'Treherbert',
...     'Usk',
...     'Porthmadog',
...     'Penmaenmawr',
...     'Llandrindod Wells',
...     'Abercwmboi'
... ]
```

2. Using Python's sets, create the following sets:

$$A = \{1, 4, 5, 10, 12\}$$
$$B = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$$
$$C = \{3, 6, 9, 12, 15\}$$

Then, using set operations, find:

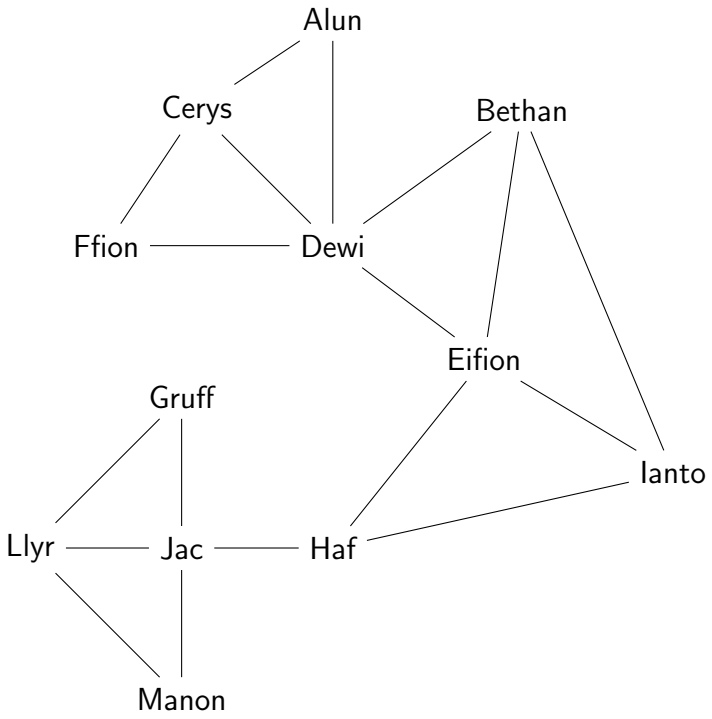
a) $A \cap B$
b) $A \cup B$
c) $A \cap B \cap C$
d) $B \setminus C$
e) $|C|$
f) $|A \cap B|$
g) $|B \setminus A|$
h) $|(A \cup B) \cap C|$
i) $|A \cup B \cup C|$

3. a) Using a while loop, create two sets, one containing all square numbers less than 1000, and another containing all cube numbers less than 1000.

   b) Is one a subset of the other?

   c) Which numbers less than 1000 are both square and cube numbers?

4. Consider the following graph of friendships between 12 children in a school:



   a) Use `networkx` to represent the social network as a graph in in Python.

   b) Using `networkx`, give the child with the most friends, that is the node with the largest `degree`.

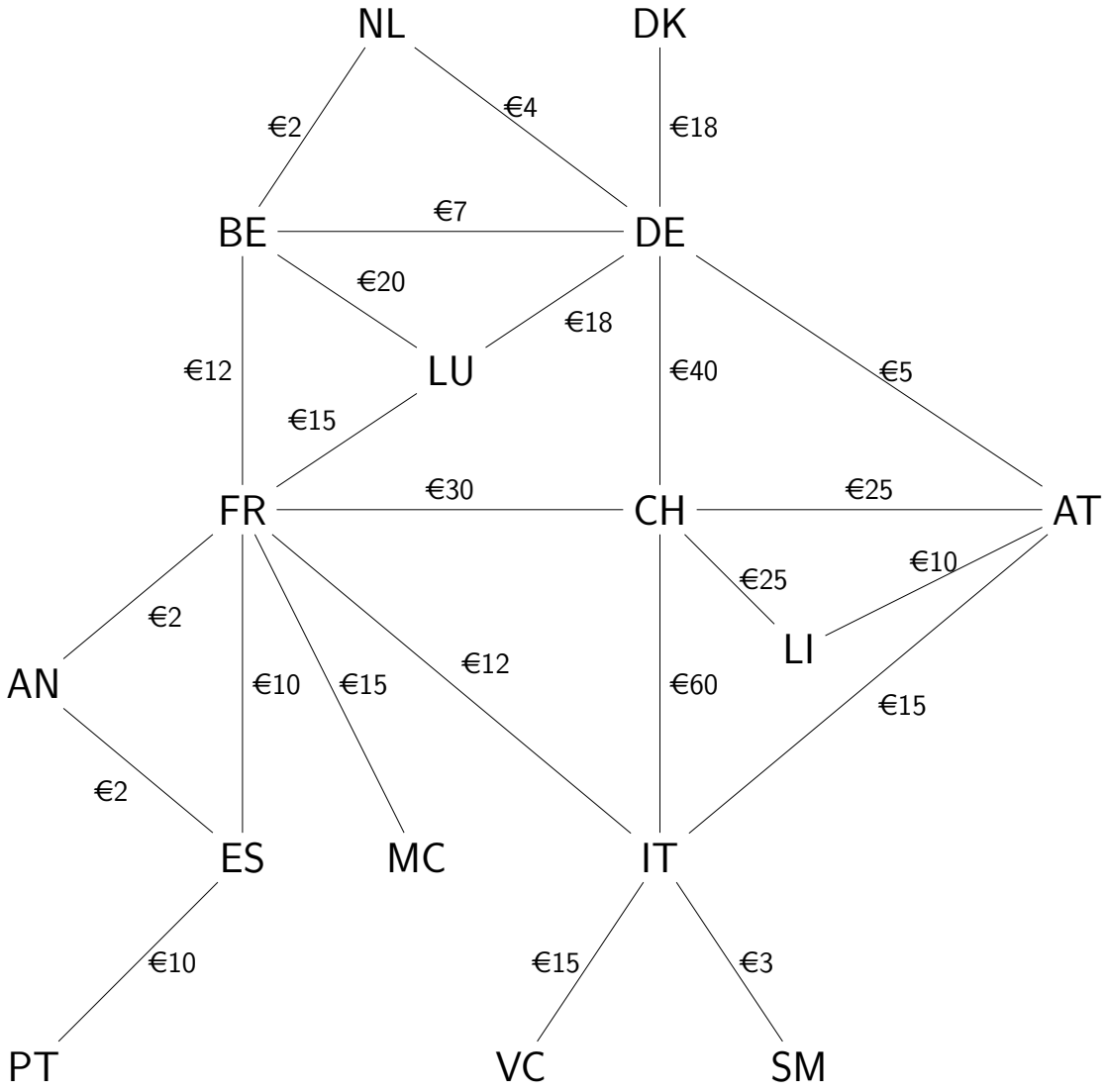
   c) Cerys would like to send a private message to Manon, but she can only send the message from trusted friend to trusted friend. What is the shortest link of friendships between Cerys and Manon?

   d) Are there any friendships that are holding the whole group together? (that is, are there any bridges?)

   e) The school would like to ask one child to spread some anti-smoking information around their friendship group, and so wants to ask the most influential child. Who should they pick? (hint: which child has the largest `closeness_centrality`?)

   f) A new girl joins the class, Non. She immediately makes friends with Cerys and Manon. Has this changes who the most influential child is?

5. Consider the following graph of European countries and the price needed to pay to pass between two countries:



a) Use `networkx` to represent the network as a graph in Python.

b) If I want to travel from Denmark (DK) to Portugal (PT), what is the cheapest path?

c) What is the least amount of money I can pay to travel from San Marino (SM) to Switzerland (CH)?

d) Which country do most shortest paths go through? (hint: `betweenness_centrality`)

e) Which border crossing do most shortest paths go through? (hint: `edge_betweenness_centrality`)

f) Find a way to colour each country such that no two countries that share a border have the same colour.