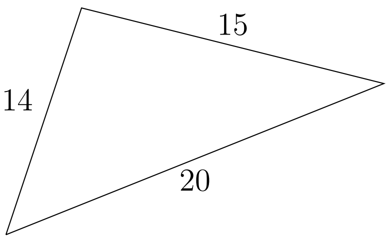
Exercises 3

1. The class below gives information about triangles:

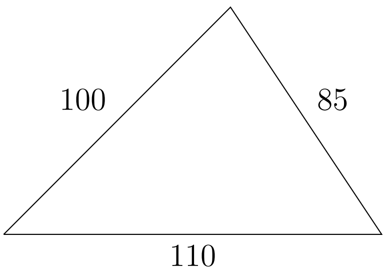
```
>>> class Triangle:
...     def __init__(self, A, B, C):
...         self.A = A
...         self.B = B
...         self.C = C
...
...     def perimeter(self):
...         return self.A + self.B + self.C
...
...     def area(self):
...         s = (self.A + self.B + self.C) / 2
...         return (
...             s * (s - self.A) * (s - self.B) * (s - self.C)
...         ) ** 0.5
```

a) Use this to build objects representing the following triangles, and find their area and perimeters:

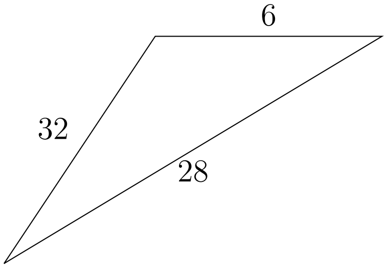
i)



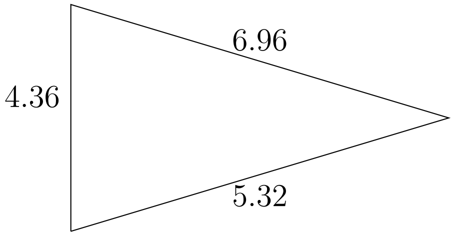
ii)



iii)



iv)



b) Add a method that returns a Boolean indicating if a triangle is isoceles or not.

c) By inheriting from the class above, create a class for *equilateral* triangles.

d) Create a list of equilateral triangles of size lengths 1, 2, ..., 9, 10. By sorting the list appropriately, find the equilateral triangle whose perimeter is closest to its area.

2. Write a class that contains information about a line. It should take in a gradient m and y-intercept c, and should contain methods that:

    - Finds a y given an x;
    - Finds an x given a y;
    - Defines a representation for the object as $mx + c$;
    - Adds itself to another line;
    - Finds the intersection between itself and another line.

    Now for the lines $y_1 = 2x + 3$, $y_2 = -5x + 2$, and $y_3 = x$, find the intersection points of:

    a) y_1 and y_2,

    b) $(y_1 + y_2)$ and y_2,

    c) y_3 and y_1,

    d) $(y_1 + y_3)$ and $(y_2 + y_3)$.

3. Consider the class below:

```
>>> import math
>>> class ComplexNumber:
...     def __init__(self, re, im):
...         self.re = re
...         self.im = im
...         self.modulus = ((self.re ** 2) + (self.im ** 2)) ** 0.5
...         self.arg = math.atan(self.im / self.re)
```

    Complete the class with the following methods:

    - `__repr__` to represent the complex number as $z = a + bi$;
    - `conjugate`, returning its conjugate $\overline{z} = a - bi$;
    - `inverse`, returning its inverse $z^{-1} = \frac{a}{a^2+b^2} - \frac{b}{a^2+b^2}i$;
    - `__add__` to add to complex numbers $z_1 + z_2 = (a_1 + a_2) + (b_1 + b_2)i$;
    - `__mul__` to multiply to complex numbers $z_1 z_2 = a_1 a_2 - b_1 b_2 + (a_1 b_2 + b_1 a_2)i$.

    Use this class to find, for $z_1 = 3 + 4i$, $z_2 = -7 - i$, and $z_3 = 6 + i$:

    a) $z_1 + z_2$

    b) $z_1 z_2 z_3$

    c) $\overline{z_2 z_3}$

    d) z_1^{-1}

    e) $\overline{z_2} + z_3^{-1}$

    f) $|z_2 + z_3|$

    g) $\arg z_1 + \arg z_3$

    h) $\arg(z_1 + z_3)$