1344. Angle between Hands of a Clock (/problems/angle-between-hands-of-a-clock/)

March 29, 2020 | 4.6K views

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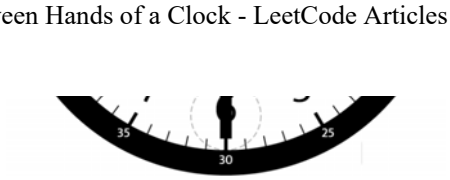
Given two numbers, `hour` and `minutes`. Return the smaller angle (in degrees) formed between the `hour` and the `minute` hand.

Example 1:

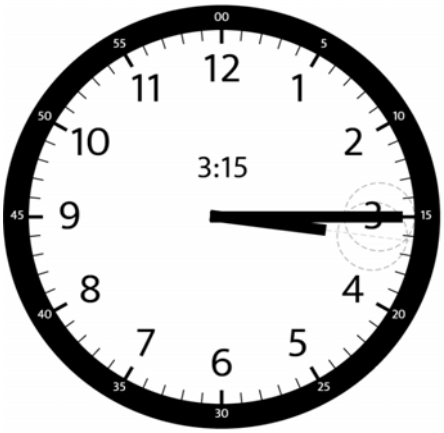

```
Input: hour = 12, minutes = 30
Output: 165
```

Example 2:




```
Input: hour = 3, minutes = 30
Output: 75
```

Example 3:




```
Input: hour = 3, minutes = 15
Output: 7.5
```

Example 4:

```
Input: hour = 4, minutes = 50
Output: 155
```

Example 5:

```
Input: hour = 12, minutes = 0
Output: 0
```

Constraints:

- `1 <= hour <= 12`
- `0 <= minutes <= 59`
- Answers within `10^-5` of the actual value will be accepted as correct.

Solution

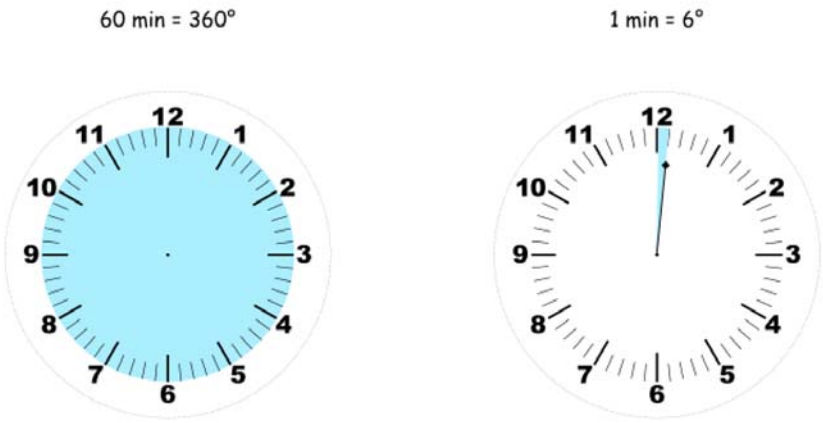
Approach 1: Math

Intuition

The idea is to calculate separately the angles between 0-minutes vertical line and each hand. The answer is the difference between these two angles.

Minute Hand Angle

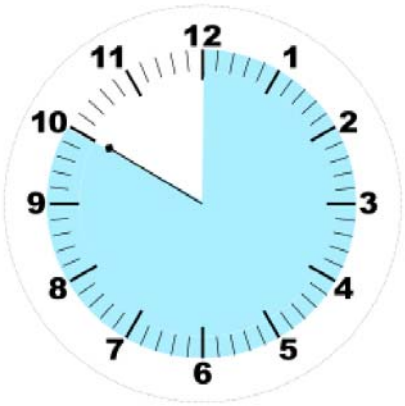
Let's start from the minute hand. The whole circle is equal to 360° or 60 minutes, *i.e.* minute hand moves $1 \text{ min} = 360^\circ / 60 = 6^\circ$ degree at each minute.



Now one could easily find an angle between 0-minutes vertical line and a minute hand: $\text{minutes\_angle} = \text{minutes} \times 6^\circ$.

5 min = 5 x 6° = 30°

50 min = 50 x 6° = 300°

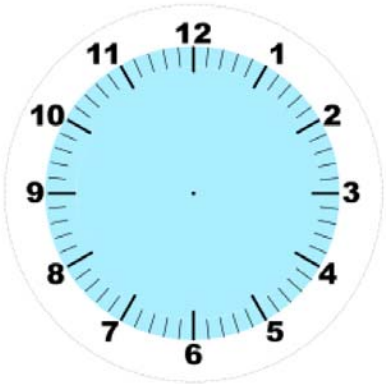


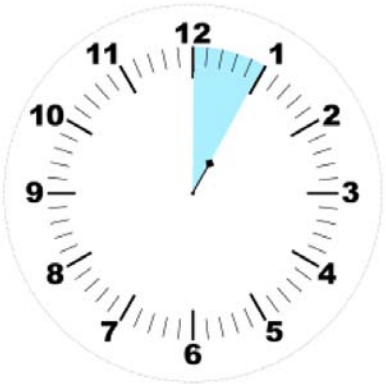
Hour Hand Angle

Similarly with the minute hand angle, the whole circle is equal to 360° or 12 hours, hence for each hour, the hour hand moves $1\text{h} = 360^\circ/12 = 30^\circ$ degree.

12 hours = 360°

1h = 360° / 12 = 30°

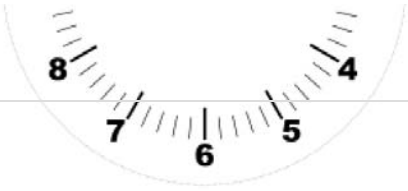
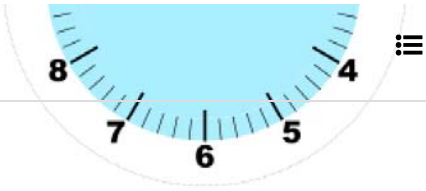




Now for the "minutes = 0" case one could easily find an angle between 12-hour vertical line and an hour hand: $\text{hour\_angle} = \text{hour} \times 30^\circ$.

1h = 1 x 30° = 30°

10h = 10 x 30° = 300°

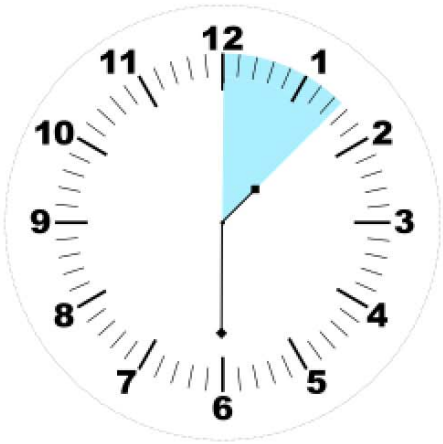



Note that for 12-hour the actual angle is zero, therefore the expression has to be corrected $\text{hour\_angle} = (\text{hour} \bmod 12) \times 30^\circ$.

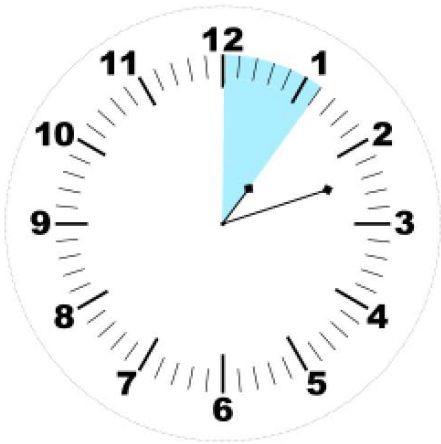
In a more general case where "minutes > 0", one has to take into account an additional movement of hour hand: it doesn't jump between the integer values but follows the movement of minute hand as well

$$\text{hour\_angle} = (\text{hour} \bmod 12 + \text{minutes}/60) \times 30^\circ$$

(1 + 30 / 60) x 30° = 45°



(1 + 12 / 60) x 30° = 36°



Algorithm

- Initialize the constants: `one_min_angle = 6`, `one_hour_angle = 30`.
- The angle between minute hand and 0-minutes vertical line is `minutes_angle = one_min_angle * minutes`.
- The angle between hour hand and 12-hour vertical line is `hour_angle = (hour % 12 + minutes / 60) * one_hour_angle`.
- Find the difference: `diff = abs(hour_angle - minutes_angle)`.
- Return the smallest angle: `min(diff, 360 - diff)`.

Implementation

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```python
class Solution:
    def angleClock(self, hour: int, minutes: int) -> float:
        one_min_angle = 6
        one_hour_angle = 30

        minutes_angle = one_min_angle * minutes
        hour_angle = (hour % 12 + minutes / 60) * one_hour_angle

        diff = abs(hour_angle - minutes_angle)
        return min(diff, 360 - diff)
```

Complexity Analysis

- Time complexity : $\mathcal{O}(1)$.
- Space complexity : $\mathcal{O}(1)$.

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This question should be easy...

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(/bshaibu)

bshaibu (/bshaibu) ★ 173 March 29, 2020 5:16 PM

Nice approach! I like that you hardcoded the degrees per hour and min (instead of writing out long formulas relative to 360 like I ended up doing). Very clean solution.

It looks like the problem statement is incorrect (and misleading). Sexagesimal (https://en.wikipedia.org/wiki/Sexagesimal) refers to base 60 numbers. It looks like all the

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Elegant move with "hour % 12 + minutes / 60". Very clean code!

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(/gomez3817)

gomez3817 (/gomez3817) ★ 8 6 hours ago

C# solution:

```
    public double AngleClock(int hour, int minutes) {
        if (hour == 12)
            hour = 0;
```

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