MATH 190-02 HW2

Matthew Mendoza

TOTAL POINTS

37 / 40

QUESTION 1

1 Question 1 **7 / 10**

- 0 pts Good job

- 2 pts You should also write it using Egyptian notation (hieroglyphs)

- 4 pts You should also write it using Egyptian notation (hieroglyphs)

✓ **- 3 pts** *For 1/12, that is already a unit fraction. You don't need to break it down further. For 2/12, that's 1/6, no need to break it down further. Etc.*

- 2 pts For 2/12, in Egyptian notation that is 1/6, not 1/12 + 1/12. Likewise for 3/12.

- 2 pts For 2/12, that's 1/6, no need to break it down further. Likewise for 3/12 = 1/4.

- 3 pts For 2/12, in Egyptian notation that is 1/6, not 1/12 + 1/12. Likewise for 3/12 and 4/12.

- 1 pts You are not allowed to use the same fraction multiple times, like you did with 8/12.

- 3 pts For 2/12, that's 1/6, no need to break it down further. Likewise for 3/12 = 1/4 and 4/12 = 1/3.

- 10 pts You were required to do Exercise 2.1 as your first problem.

QUESTION 2

2 Question 2 **10 / 10**

✓ **- 0 pts** *Good job!*

- 2 pts For part (b) and (d), the numbers should all be integers. So 3/5 and 13.8 are not the answer. Use another decimal digit to accomplish this.

- 3 pts Great job on finding the fractions. But you forgot to write it in Babylonian notation.

- 6 pts You only submitted part (d). You missed the other four parts.

- 4 pts You're on the right track, but say more than this.

- 2 pts Show your work for how you got to that number.

QUESTION 3

3 Question 3 **10 / 10**

✓ **- 0 pts** *Good job!*

- 5 pts No progress for two parts.

- 3 pts Notice that most of the numbers are divisible by 60, or close.

- 1 pts Show more work.

QUESTION 4

4 Question 4 **10 / 10**

✓ **- 0 pts** *Good job!*

- 3 pts You have identified the correct approach. But why does it work?

- 4 pts Show the steps to solve it.

- 7 pts Explain mathematically why it always works.

- 0 pts How does it relate to base 60?

- 10 pts A fourth problem was not submitted.

- 4 pts I think you're on the right track, but this is not a complete explanation.

- 2 pts Close, but that's not quite their approach.

— Exercises —

Exercise 2.1. Express $\frac{1}{12}, \frac{2}{12}, \frac{3}{12}, \ldots, \frac{11}{12}$ as Egyptian fractions. Use as few parts as you can, and do not use the same part more than once (for example, you should not write $\frac{5}{12}$ as $\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12}$). Write your results in both Egyptian and modern notation.

Recall

1 = | , 10 = ∩ , 100 = 𓍢 , 1,000 = 𓆼

10,000 = 𓂭 , 100,000 = 𓆐 , 1,000,000 = 𓁨

Of course, Egyptians didn't write things using our modern "$\frac{1}{n}$" notation. They wrote $\frac{1}{n}$ by either placing a dot or an oval above the number n (the dot and oval symbols mean "part" or "mouth"). For instance:

10 = ∩ $\frac{1}{10}$ = ∩̇

3 = ||| $\frac{1}{3}$ = 𓂋|||

This gave them a symbol for each unit fraction, but except for two exceptions, these were the only fractions they could write directly.[5] They then expressed all other fractions as a sum of distinct[6] unit fractions. For example, to write $\frac{2}{5}$, they would use the fact that

$$\frac{2}{5} = \frac{1}{3} + \frac{1}{15}.$$

And so, $\frac{2}{5}$ would be written as

𓂋||| 𓂋∩||||| .

A second drawback is the fact that each representation is not unique. One way to see this is to simply note that

$$* \quad \frac{1}{n} = \frac{1}{n+1} + \frac{1}{n(n+1)}.$$

Egyptian, Modern

$* \frac{1}{12}$ = 𓂋∩||| 𓂋𓍢∩∩∩∩∩||||||, $\frac{1}{13}+\frac{1}{156}$

equivalent

$\frac{1}{6}$ $\frac{2}{12} = \frac{1}{6} = \frac{1}{6+1} + \frac{1}{6(6+1)}$

𓂋||||||| 𓂋∩∩∩∩||, $\frac{1}{7}+\frac{1}{42}$

$\frac{1}{4}$ $\frac{3}{12} = \frac{1}{4} = \frac{1}{4+1} + \frac{1}{4(4+1)}$

𓂋||||| 𓂋∩∩, $\frac{1}{5}+\frac{1}{20}$

$\frac{1}{3}$ $\frac{4}{12} = \frac{1}{3} = \frac{1}{12+1} + \frac{1}{12(12+1)}$

𓂋∩||| 𓂋𓍢∩∩∩∩∩||||||, $\frac{1}{13}+\frac{1}{156}$

can reduce

$\frac{5}{12} = \frac{4}{12} + \frac{1}{12}$

𓂋|||| 𓂋∩||, $\frac{1}{4}+\frac{1}{12}$

$\frac{1}{2}$ $\frac{6}{12} = \frac{1}{12} + \frac{4}{12}\}\frac{1}{3}$

𓂋∩|| 𓂋|||, $\frac{1}{12}+\frac{1}{3}$

$\frac{7}{12} = \frac{1}{12} + \frac{6}{12}\}\frac{1}{2}$

𓂋∩|| 𓂋||, $\frac{1}{12}+\frac{1}{2}$

$\frac{2}{3}$ $\frac{8}{12} = \frac{2}{12}\}\frac{1}{6}\ \ \frac{6}{12}\{\frac{1}{2}$

𓂋|||||| 𓂋||, $\frac{1}{6}+\frac{1}{2}$

$\frac{3}{4}$ $\frac{9}{12} = \frac{3}{12}\{\frac{1}{4}\}\ \frac{6}{12}\{\frac{1}{2}\}$

𓂋|||| 𓂋||, $\frac{1}{4}+\frac{1}{2}$

$\frac{5}{6}$ $\frac{10}{12}$ = Better to just reduce → $\frac{2}{6}\{\frac{1}{3}\}\ \frac{3}{6}\{\frac{1}{2}\}$

𓂋||| 𓂋||, $\frac{1}{3}+\frac{1}{2}$

$\frac{11}{12} = \frac{1}{12}\quad \frac{10}{12}\{\frac{1}{3}+\frac{1}{2}\}$

𓂋∩|| 𓂋||| 𓂋||, $\frac{1}{12}+\frac{1}{3}+\frac{1}{2}$

1 Question 1 **7 / 10**

- **- 0 pts** Good job
- **- 2 pts** You should also write it using Egyptian notation (hieroglyphs)
- **- 4 pts** You should also write it using Egyptian notation (hieroglyphs)

✓ **- 3 pts** *For 1/12, that is already a unit fraction. You don't need to break it down further. For 2/12, that's 1/6, no need to break it down further. Etc.*

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- **- 10 pts** You were required to do Exercise 2.1 as your first problem.

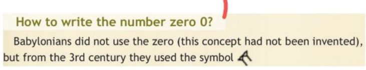
Exercise 2.2. Read Sketch 4. Parts (a)-(d): Write the following numbers in expanded sexagesimal notation (eg., $71\frac{1}{4} = 1, 11; 15$), then translate into Babylonian notation.

(a) $120\ \frac{1}{3}$

$60^1 \quad 60^0 \quad$ Fractionals $\quad \frac{1}{3} = \frac{20}{60}$

$$\underbrace{(2\times 60) + 0 + (20 \times \tfrac{1}{60})}_{\text{Expanded sexagesimal Notation}}$$

$$\underbrace{2.0;20}_{\text{Babylonian Notation (Cuneiform)}}$$


How to write the number zero 0?
Babylonians did not use the zero (this concept had not been invented), but from the 3rd century they used the symbol

(b) $\frac{1}{100}$

$$\frac{1}{100} = \frac{x}{60} \Rightarrow \frac{60}{100} = \frac{100x}{100}$$

$$\underbrace{x = 0.6 \ldots\ 100 > 60, \text{ so}}_{\text{Expanded sexagesimal Notation}}$$

$$\underbrace{0;0,36}_{\text{Babylonian Notation (Cuneiform)}}$$

The Babylons did not use a symbol to indicate where the fractional part begin. It was based on the context.

(c) $12\frac{1}{5}$

$60^0 \quad$ Fractionals

$$\underbrace{12 + (\underbrace{\tfrac{1}{5} \times 60}_{0.2\cdot 60 = 12})}_{\text{Expanded sexagesimal Notation}}$$

$$\underbrace{12;12}_{\text{Babylonian Notation (Cuneiform)}}$$

(d) 81.23

$60^1 \quad 60^0 \quad$ Fractionals

$$(1\times 60) + 21 + (\underbrace{0.23\times 60}_{13.8})$$

$0.8 \times 60 = 48$

Expanded sexagesimal Notation

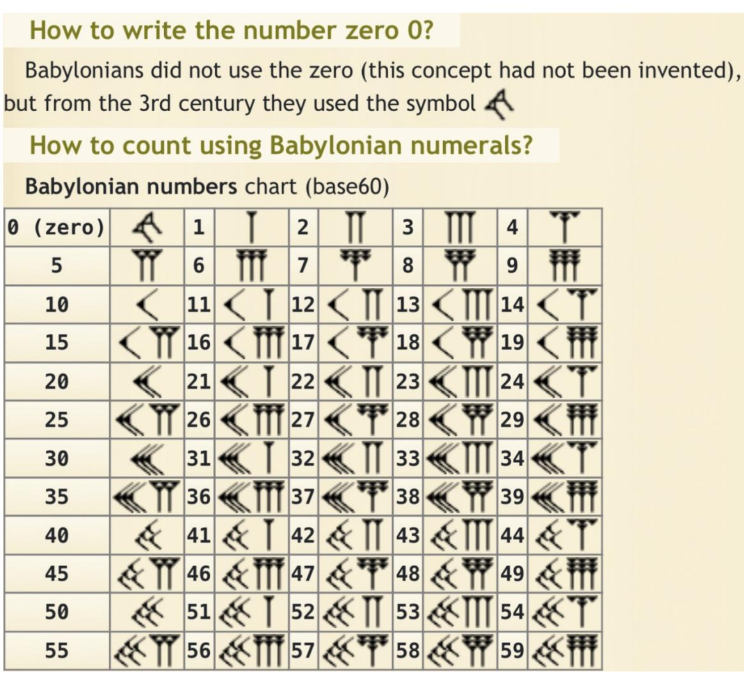
$$1.21;13.48$$

Babylonian Notation (Cuneiform)

Part (e): What notation would you add to the Babylonian system to make their numerals easier to decipher?

I would add a butterfly (⋈), so it would serve as my "floating point" as the separator between whole numbers and fractional values (eg 81.23 = )

Babylonian Notation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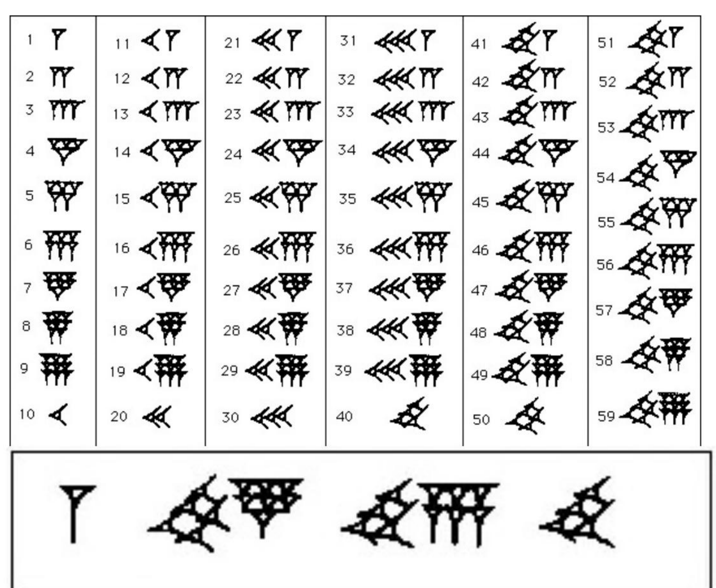
How to count using Babylonian numerals?

Babylonian numbers chart (base60)



1,57,46,40 = 424000

2 Question 2 **10 / 10**

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- 3 pts Great job on finding the fractions. But you forgot to write it in Babylonian notation.

- 6 pts You only submitted part (d). You missed the other four parts.

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- 2 pts Show your work for how you got to that number.

Exercise 2.3. The prevalence of computers has led to increasingly common usage of decimals to express fractional parts. Give two advantages and two disadvantages to writing fractions in decimal form.[24]

Disadvantages

Loss of precision

edit fork download

```python
result = 1.0 / 3.0
print("Result in Python:", result)
```

Success #stdin #stdout 0.03s 9528KB

stdin

Standard input is empty

Sometimes will produce a four

stdout

Result in Python: 0.3333333333333333

Precision to the 16^{th} place

can't express in its true decimal form and may have rounding errors. It may also cause promotion/demotion issues in data

by extension →

Complex fractions

edit fork download

```python
result = 1.0 / 7.0
print("Result in Python:", result)
```

Success #stdin #stdout 0.03s 9512KB

stdin

Standard input is empty

stdout

Result in Python: 0.14285714285714285

Fractions converted to decimal may result into long, non-repeating, non-terminating decimals

Advantages

Ease of comparison: Decimals allow one to make comparison; for as fractions $\frac{1}{2}, \frac{4}{8}, \frac{8}{16}$ are the same, so representing as decimal it's easy to validate if $0.5 \equiv 1.5$

Compatibility: When it comes to calculations or finances the decimal system allows "data flow", for example, from one calculation software into a financial application (ie numbers to dollars)

3 Question 3 **10 / 10**

✓ **- 0 pts** *Good job!*

- 5 pts No progress for two parts.

- 3 pts Notice that most of the numbers are divisible by 60, or close.

- 1 pts Show more work.

Exercise 2.4. Some Babylonian texts say "seven has no inverse." What do you think they meant by this?

It is to denote that there is no whole number or fraction that can be multiplied by 7 to produce a whole number.

For example: $7 \times x = 1$

7 is a prime number, and so there was no way to divide 7 into equal parts. They can represent denominators of 7 as approximations in their sexagesimal notation, but not accurately

This holds true for other fractions like

$\frac{1}{3}$, $\frac{1}{5}$, and $\frac{1}{11}$

4 Question 4 **10 / 10**

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- 3 pts You have identified the correct approach. But why does it work?

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