

Midterm - INTD290

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1 How to Submit this Midterm

1. Complete your work on this midterm.
2. Scan it into PDF form using a smartphone app, scanner, or digital picture
3. Alternatively you can type up your answers in a separate file, but it still must be a PDF
4. Submit it using the link on Moodle

2 Maps of The New World

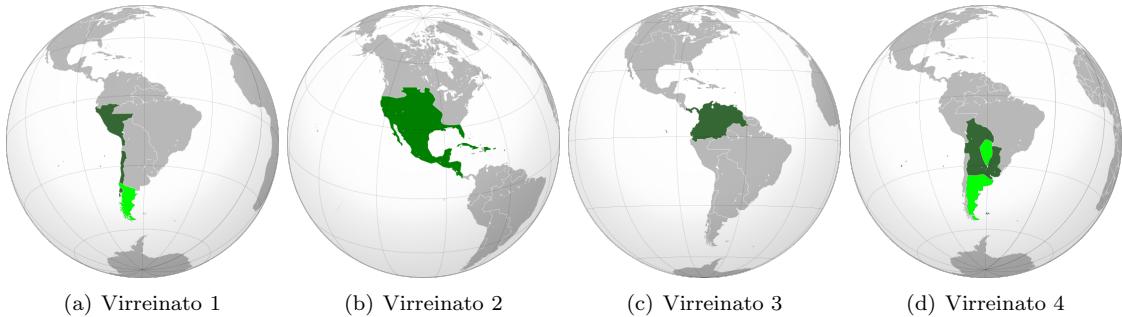


Figure 1: There were up to four *virreinatos* during the Spanish colonial period of Latin American history.

1. In which of the four *virreinatos* of the Spanish colonial empire (shown in Fig. 1) was the *tle huiztilin* classified by the indigenous? **(B) by the Nahua**
 2. Which of the four *virreinatos* excelled at the exportation of rum?
(C)
 3. Which of the four *virreinatos* was characterized by an indigenous empire that mastered agriculture in the Andean mountains?
(A) by the Incas
 4. The low-latitude aurora of 1789 was observed in *which cities?* In which of the four virreinatos are these cities? List some other countries in which corresponding observations were made.
 5. List some of the locations explored by La Condamine and his Latin American colleagues, and cite the virreinato or virreinatos they explored together.
 6. The Expedición Botánica of José Celestino Mutis took place in which virreinato?
(C)
 7. José Celestino Mutis took place in which virreinato? Mutis was the inaugural chair of the department of mathematics at the *Colegio del Rosario*. In which city is this?
(C) Bogata, Colombia
 8. In which country is the Pierre Auger Observatory located? In which virreinato would this country have been in the 18th century?
(D) Argentina
-
4. Mexico City, Guanajuato, Veracruz, San Luis Potosí, Puebla, Guadalajara, Zacatecas and Oaxaca (B), observations were also made in Spain, Sweden, England, Poland, Cuba
 5. They mostly explored Quito, but they also went to Guayaquil, San Pedro de Riobamba, and the Province of Esmereldas (C)



Figure 2: (Left) A physics detector near Pico de Orizaba in Mexico. (Right) A town in central Mexico.

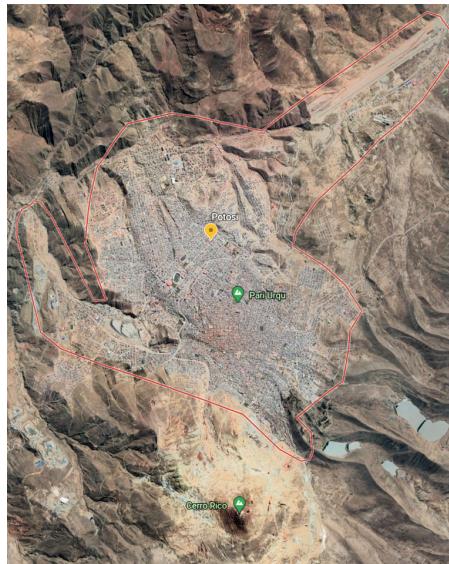


Figure 3: A historical location in Latin America known for driving a particular economic sector.

3 Asynchronous Activity Review I

- What is the physics detector shown in Fig. 2 (left)? Explain in basic terms the purpose of this detector and how it works.

The HAWC (high altitude water chamber) Gamma-ray Observatory is a detector in the Sierra Negra mountains in Mexico. When gamma rays travel to Earth from outerspace, they have an incredible amount of energy, yet we can't see them. However, when these rays hit a pool of water, the electromagnetic wave refracts and forms visible blue light. At this observatory, there are many Cherenkov sensors that detect and document this light. Then, scientists are able to use math to find where the ray came from.

- What is the significance of Mexican cities as pictured in Fig. 2 (right), in the context of the development of colleges and the scientific community in 18th century Mexico?

Real de Catorce is an old mining town, and in the 18th century, this meant there was a rush of economic growth. This happened in several cities throughout Mexico, and the silver boom also attracted scientists and academics to establish themselves there. There was a big increase in mining colleges and growth in both silver and knowledge.

- What city is being shown in Fig. 3? In which country is it located, and what was the historical significance of this city for international trade? Who controlled it? From where the commodity produced here originate, and how was it shipped to Europe and Africa?

Potosí is a mining city in Bolivia located right near a mountain with a huge silver deposit. By producing wealth in the virreinato, the silver trade in Potosí made Spain richer. Much of it was sent in boats to Europe and Africa, but some was also minted into the Spanish dollar coin.

4 Asynchronous Activity Review II

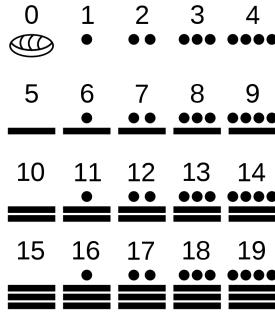


Figure 4: A list of the numerical digits used by the Maya.

1. Work out the following addition problems *using the Mayan system*.

(a) $80 + 20 =$

(b) $365 + 365 =$

(c) $1024 + 512 =$

2. Work out the following subtraction problems *using the Mayan system*.

(a) $1024 - 512 =$

(b) $92 - 31 =$

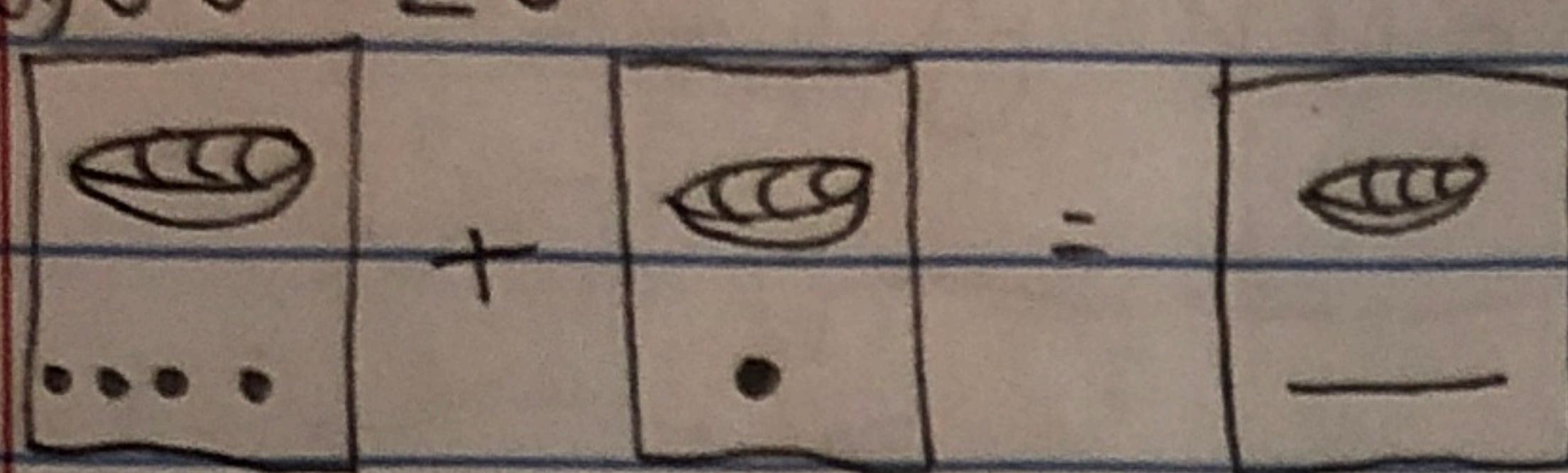
3. Work out the following addition problems *using the Incan quipu*:

(a) $512 + 256 =$

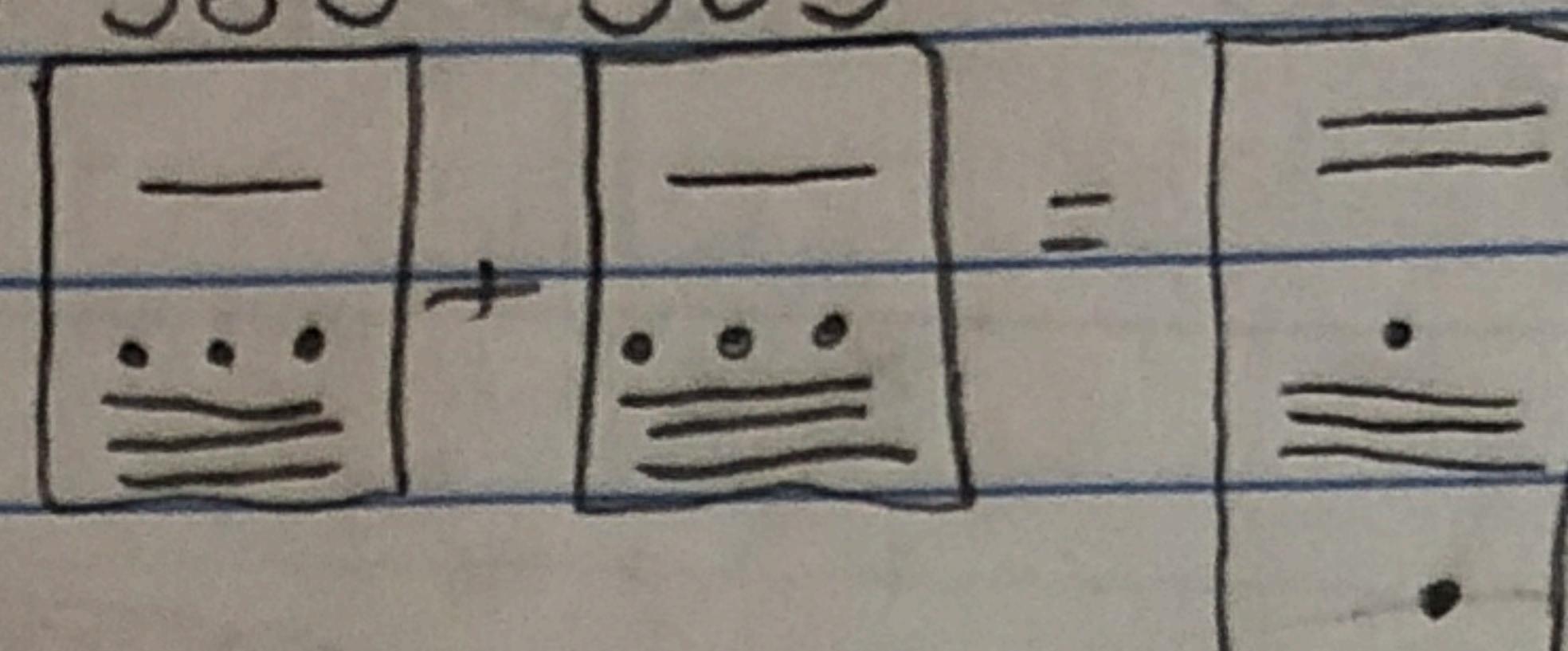
(b) $11 + 89 =$

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1. a) $80 + 20$



b) $365 + 365$

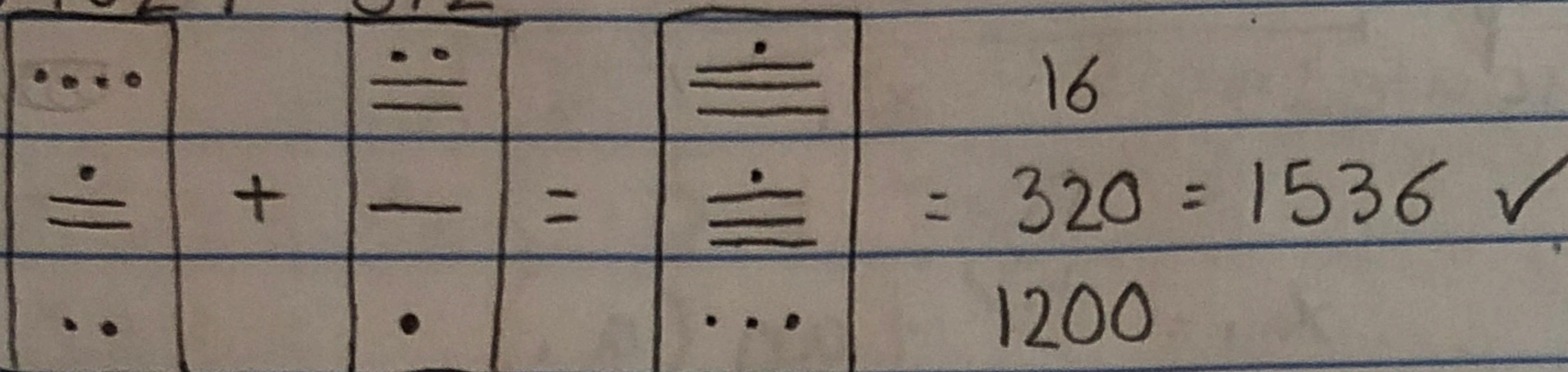


$$20^{\circ} \times 10$$

$$= 20^{\circ} = 320 = 730 \checkmark$$

$$20^2 = 400$$

c) $1024 + 512$

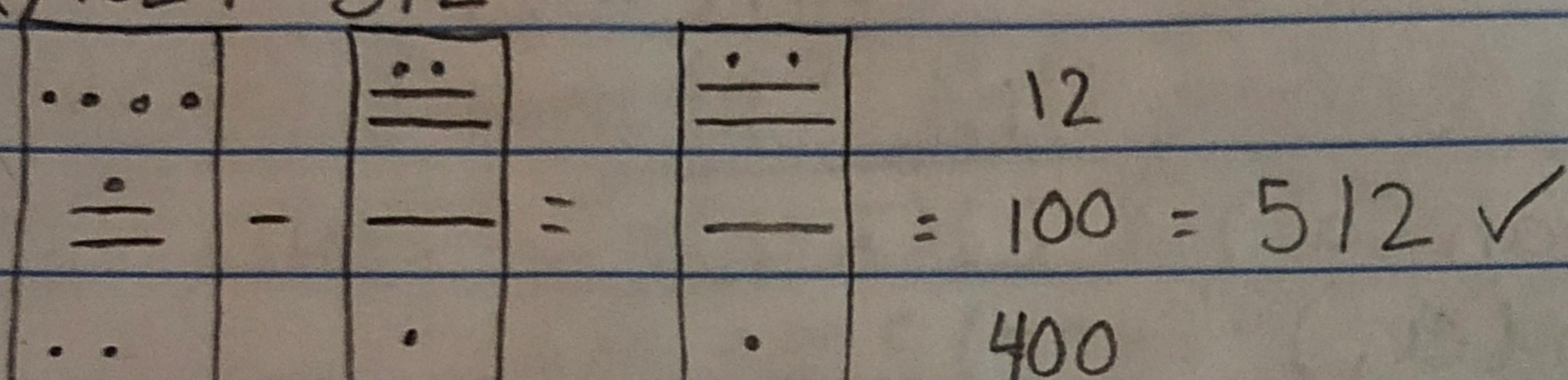


$$16$$

$$= 320 = 1536 \checkmark$$

$$1200$$

2. a) $1024 - 512$

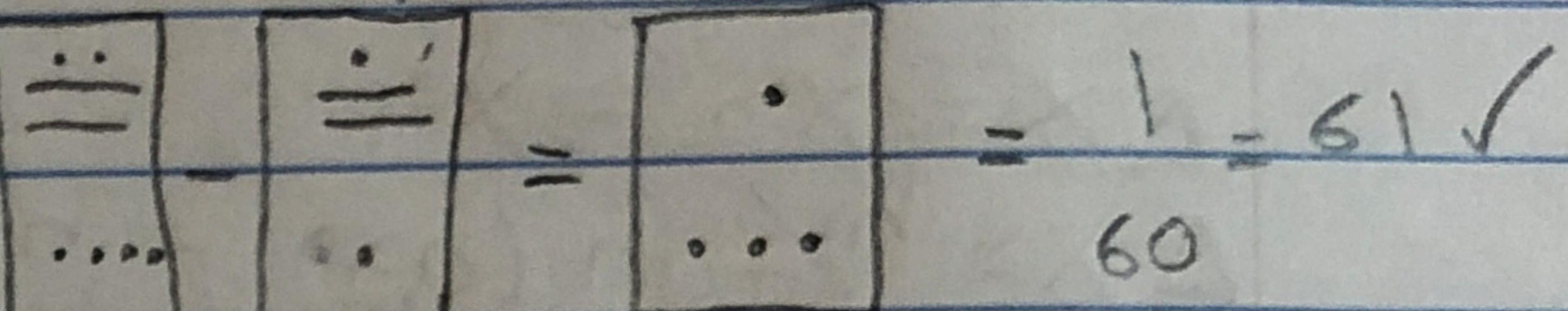


$$12$$

$$= 100 = 512 \checkmark$$

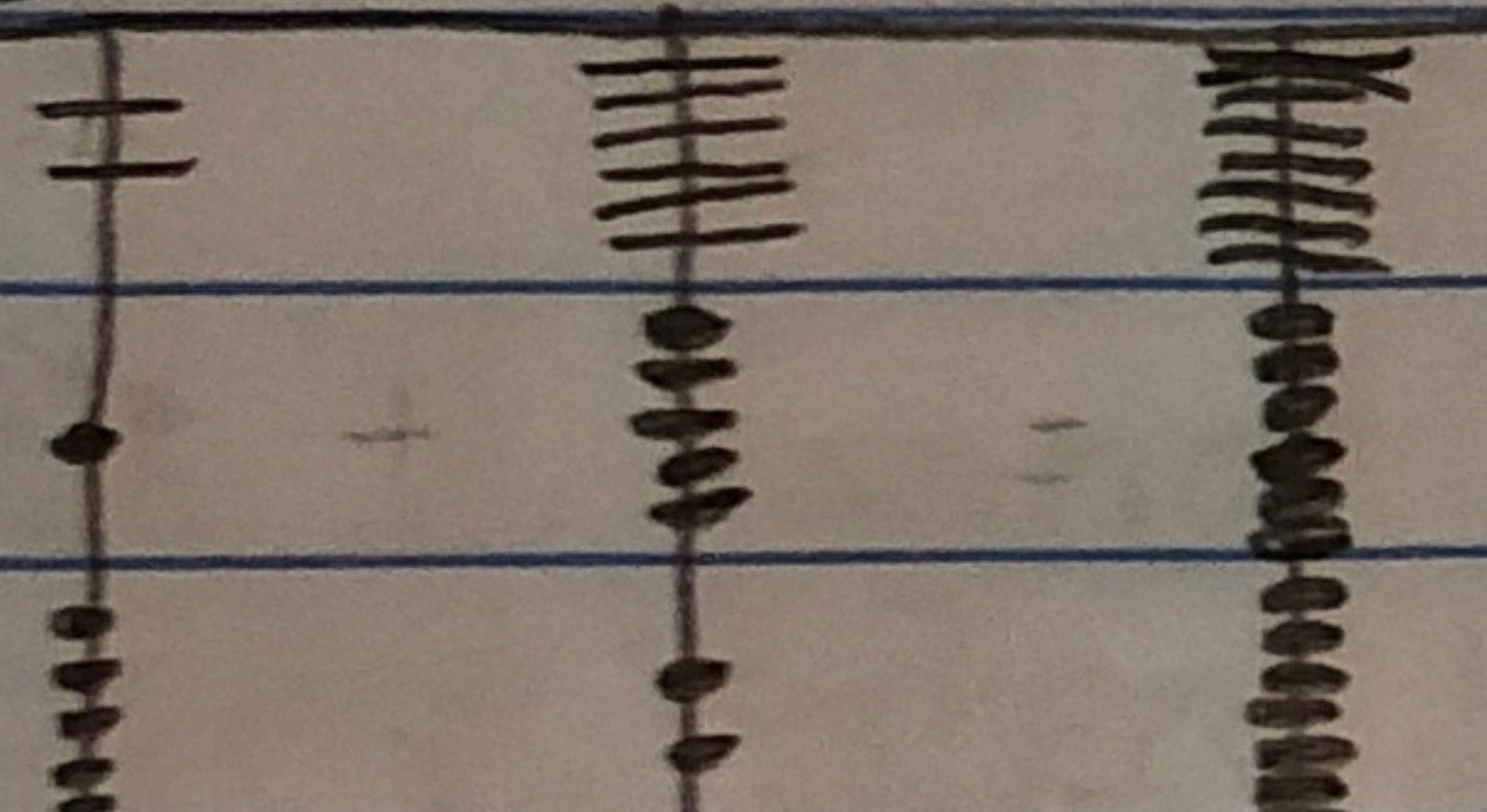
$$400$$

b) $92 - 31$



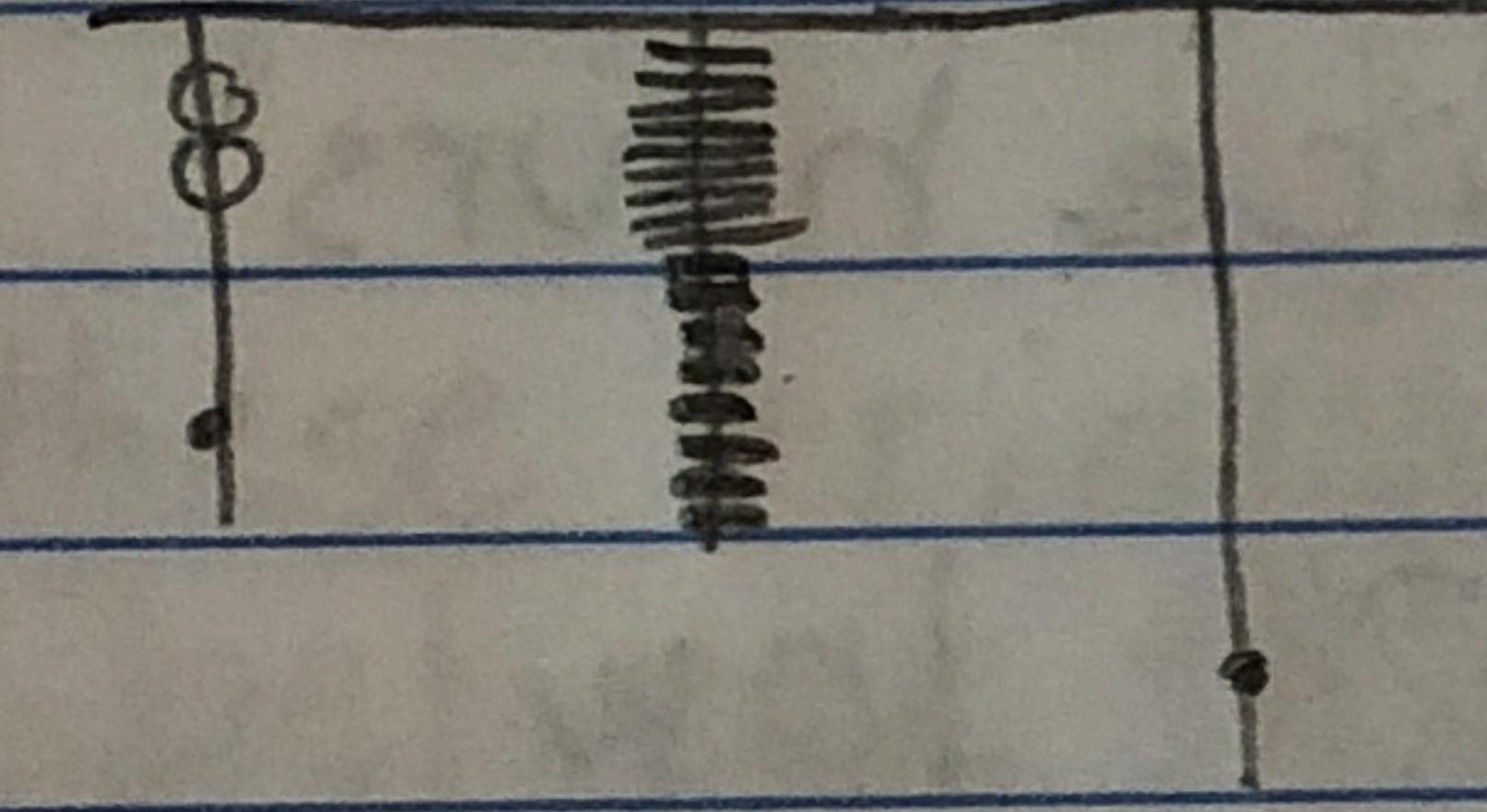
$$60$$

3. a) $512 + 256$

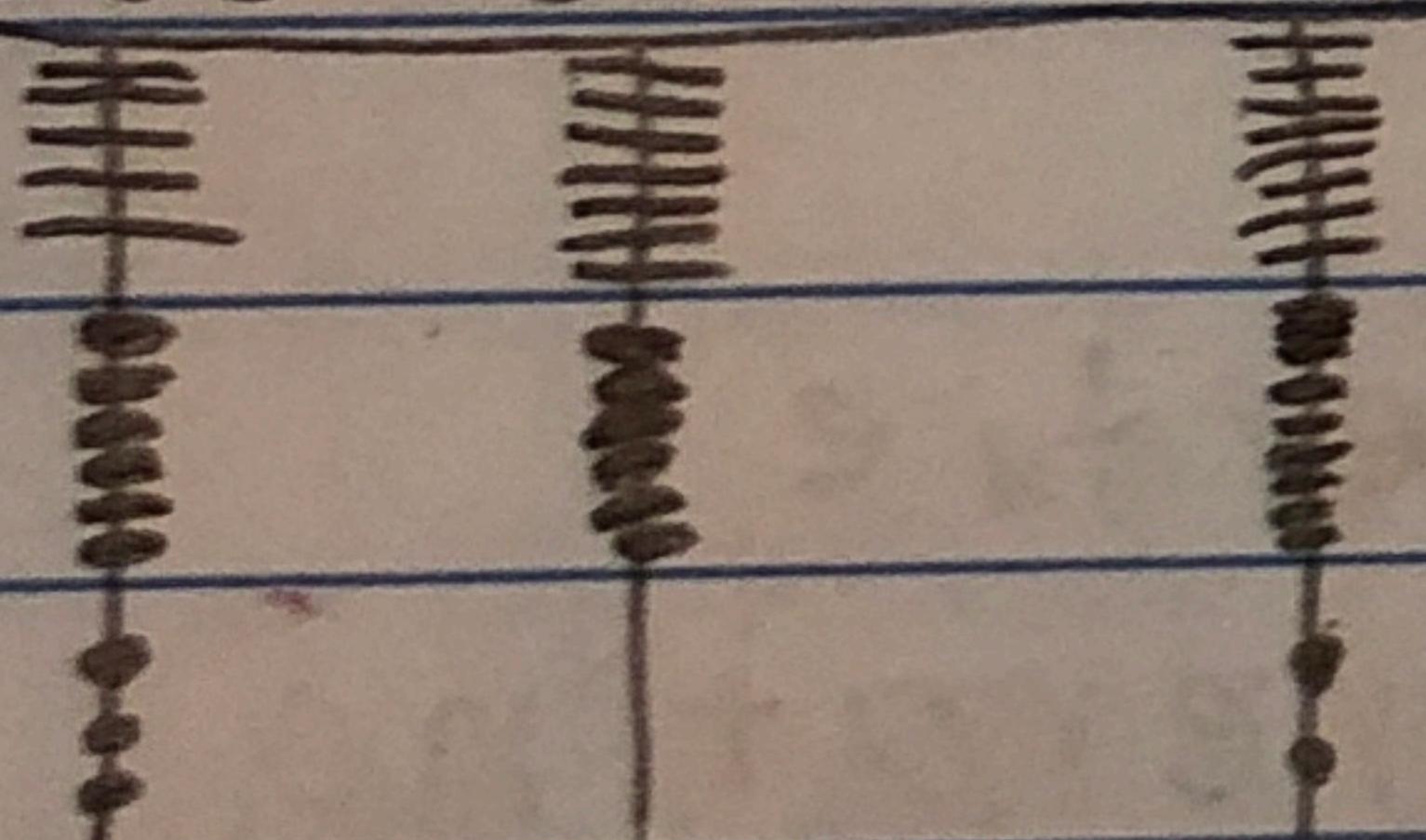


$$(768)$$

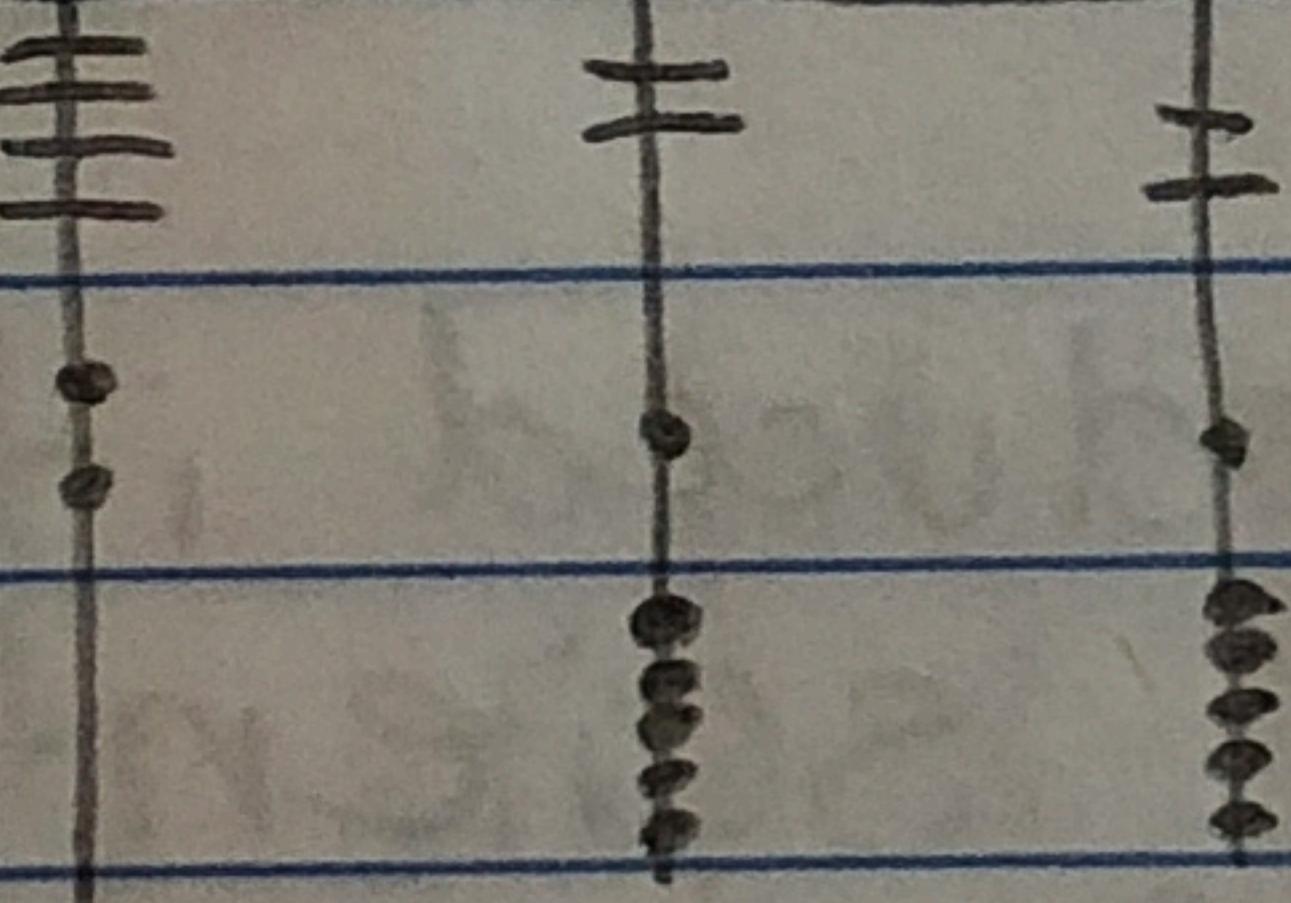
b) $11 + 89$



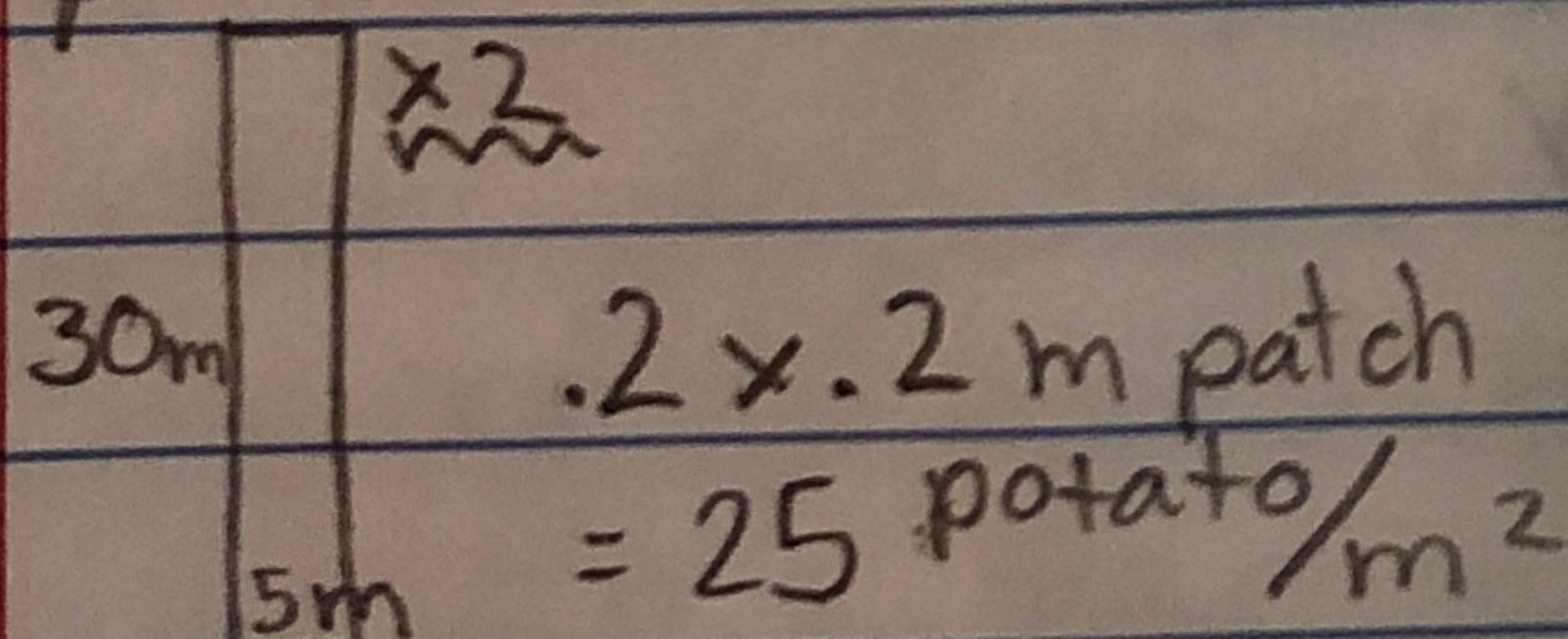
4. a) $365 - 67$



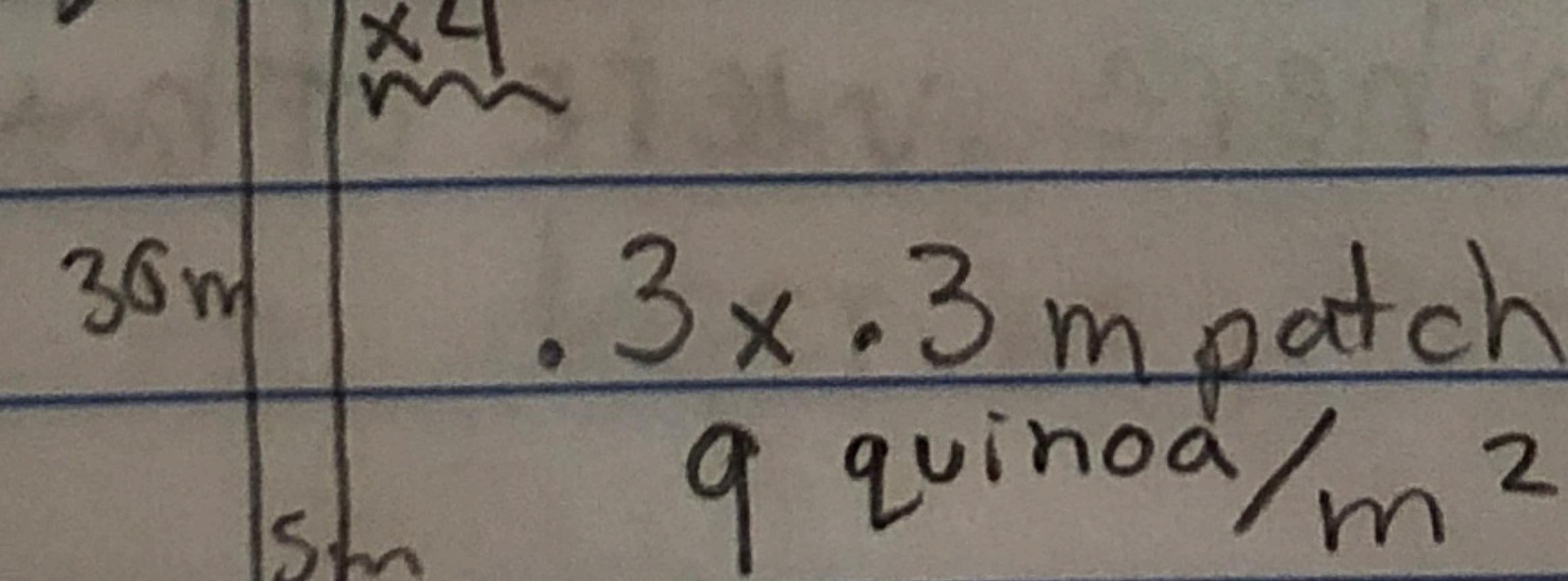
b) $1024 - 512$



5. potato



quinoa



area per terrace

$$= 30 \times 5 = 150 \text{ m}^2$$

$$150 \text{ m}^2 \times 25 \text{ potatos/m}^2 \times 2 = 7,500$$

$$150 \text{ m}^2 \times 9 \text{ quinoa/m}^2 \times 4 = 5,400$$

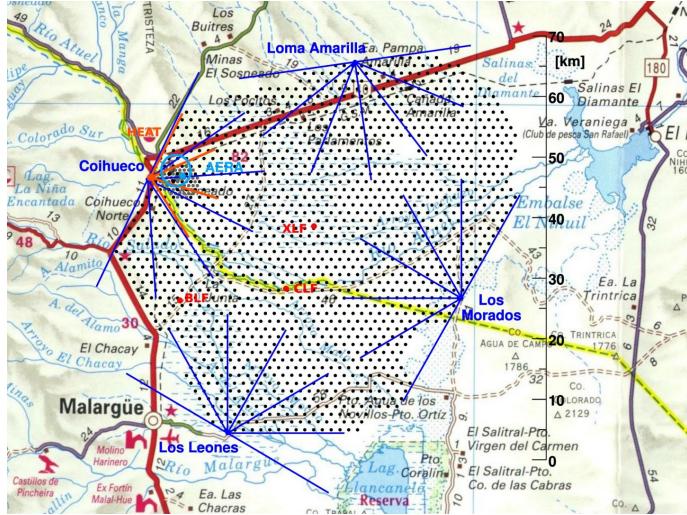


Figure 5: A physics detector near Malargüe, Argentina.

4. Work out the following subtraction problems *using the Incan quipu*:

(a) $365 - 67 =$

(b) $1024 - 512 =$

5. Suppose you have three terrace plots in the Andean mountains to use to survive. You and your cohort of fellow Incans decide to grow potatoes and quinoa. Quinoa actually do better at higher altitudes than potatoes. So the plan is to use the two lowest terraces for potatoes, and the upper four for quinoa. Each terrace is 30 meters by 5 meters. A potato plant requires a 0.2 meter by 0.2 meter patch, and a quinoa plant requires a 0.3 meter by 0.3 meter patch. How many potato plants and how many quinoa plants can you plant? Store the results in a diagram of quipu knot system.

5 Connection to Physics

1. In Fig. 5, what physics detector is shown?

- A: The Large Hadron Collider
- B: The IceCube Neutrino detector
- C: The Pierre Auger Observatory
- D: The High Altitude Water Cherenkov detector

2. What is the purpose of the physics project shown in Fig. 5?

- A: To collide protons and nuclei to probe sub-atomic physics
- B: To detect signals from neutrinos that originate outside the solar system
- C: To detect cosmic rays that originate outside the solar system
- D: To detect gamma rays from space

3. What is a gamma ray?

- A: A photon of light
- B: A proton or nucleus from deep space
- C: A portion of the aurora borealis
- D: An ion floating in the atmosphere

4. What is located at each black dot in Fig. 5?

- A: A water tank designed to record Cherenkov radiation
- B: A radio receiver designed to record radio pulses
- C: An optical sensor designed to record visible light
- D: A telescope designed to detect infrared radiation

6 Vocabulary

1. What is the meaning of the term *rationalism*?

- A: The idea that reason rather than experience is the foundation of certainty in knowledge
- B: Encapsulating the idea of *I think, therefore I am.*
- C: Using scientific instruments
- D: Relying on measurements and sensory experience to discover the truth

2. What is the meaning of the *Nahuatl* term *abuizotl*?

- A: A horse
- B: A hummingbird
- C: An otter
- D: An alligator

3. What is the meaning of the *Nahuatl* term *tomatl*?

- A: Smoked fish
- B: Smoked chili
- C: An herb to help digestion
- D: A tomato

4. What is *cinchona*?

- A: An herb used to treat indigestion
- B: A shrub or tree used to create quinine
- C: A flower used in religious rituals of the *Mexica* people
- D: A plant that can form a treatment for syphilis

5. Define the word *torpor*, as it pertains to animal behavior.

- A: The ability hover in midair during flight using rapid wingbeats
- B: Lowering internal body temperature and metabolism to levels that render the individual immobile and in a hibernating state
- C: The ability to break open the shells of mollusks using tools
- D: The ability to distinguish complex sounds in songs or calls

6. Who were the *Jesuits*?

- A: Formally known as the Order of Preachers, this is a Catholic order founded by Saint Dominic
- B: Formally known as the Order of Friars Minor, this is a Catholic order founded by Saint Francis
- C: Formally known as *Los Amigos del País*, these were mining officials who formed guilds to further economic interests of their region
- D: Formally known as the Society of Jesus, this is a Catholic order founded by Saint Ignatius of Loyola

7 Free Response Section

1. **Kepler's Laws, and Newtonian Physics** Discuss the varying levels of acceptance within scientific and academic communities in Nueva Granada and Perú in the late 18th century.

Much of Nueva Granada and Peru were traditional and believed in Scholasticism, more traditional theories that don't allow room for new experimentation and knowledge. Some scientists, European or South American, however, did want to shift into an Empirical mindset and push ourselves to learn much more about our universe. While professors were able to bring this up in their academic communities, no change was made to any curriculums, as the Crown stayed in control. Eventually, the Jesuits gained control of education and began to teach Newtonian physics systematically.

2. **The aurora of 1789** Discuss the significance of the aurora borealis in 1789 that was visible from Mexico City. List several researchers who made observations of this aurora and other auroras, and explain what they found.

José Antonio Alzate y Ramírez, José Francisco Dimas Rangel, and Antonio de León y Gama were three Mexican scientists who made the first scientific observation and analysis of low latitude auroras. Before this, European scientists believed that auroras could not be seen below 35 degrees North, but the 1789 aurora was at 16.8 degrees. This aurora was also red, indicating different compounds in the atmosphere, and the scientists were able to use geometry to find how high in the atmosphere the aurora was.

3. **Herbal medicine in the 16th century** Give several examples of treatments for various ailments in the body used by Europeans and indigenous Latin Americans in the 16th century. Explain the theory of the four humors and why this influenced the European treatments but not the indigenous ones.

The four humors was a medieval theory of medicine believed in Europe for a long time, and broke down the body into 4 distinct fluids. Each fluid has a temperature, color, and moisture level and even relates to the 4 earthly elements. This theory formed the basis for European medicine, but since indigenous groups had a different approach, their methods didn't always fit.

For dysentery or diarrhea, Europeans recommended manure, ground pig feet, or dog urine all mixed with wine, while the Nahua used local herbs and fruit. For broken bones, Europeans said to bake goat manure with wine and spread it over the bone, while the Nahua set the bone and applied herbs to the open wound. In both cases, the Nahua use methods much more similar to what we use today.

4. **The Inquisition, the Catholic Church, and Scientific Traditions** Discuss several examples of the following:

(a) Catholic censorship of knowledge flowing from Europe to Latin America (b) Catholic censorship of knowledge flowing from Latin America to Europe (c) contributions to Latin American science by Catholic scholars and explorers (d) knowledge that was recorded or translated from indigenous sources by Catholic priests, monks, or nuns.

a) Many universities were controlled by Catholics, and the spread of information from Europe was very slow. Printing presses, books, and pedagogy were censored

b) Scientific research and discoveries done by Latin American scientists was not taken seriously by Catholics in power, so important information like herbal medicines proven to work and low-latitude aurora data wasn't shared with Europe for a long time. They also condemned certain scientists.

c) Many missionary groups were involved in mapping the northern and southern limits of Spanish America. Bishop Martínez Compañón published a 9 volume description of the plants and animals of the Bishopric of Trujillo.

d) knowledge that was recorded by Catholic figures of Latin American science is unreliable as we know the writers often had a skewed perspective when documenting science they themselves didn't understand. Some examples of Catholic documentation include Jose Gumilla's book on Amazon river life and governments, or Jean-Baptiste Labat's book on the islands of the Americas.