

# Midterm - INTD290

49.5  
50

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

February 4, 2021

Well done!

## 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

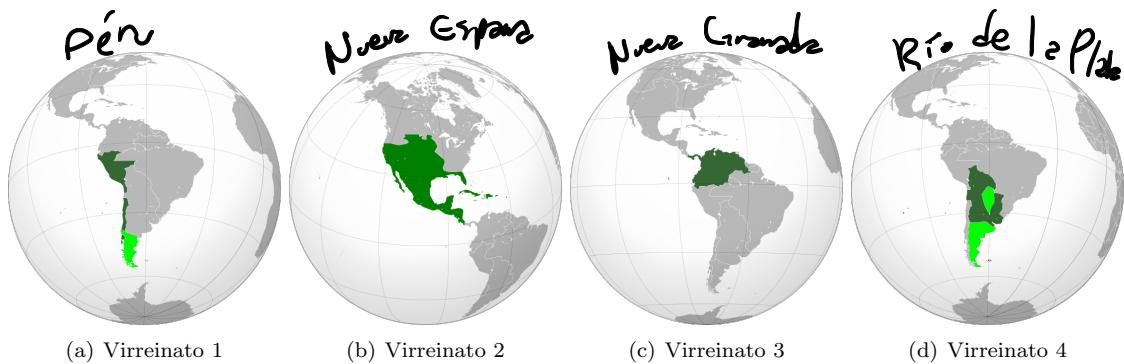


Figure 1: There were up to four *virreinatos* during the Spanish colonial period of Latin American history.

1. In which of the four *virreinatos* of the Spanish colonial empire (shown in Fig. 1) was the *tlé huitzilin* classified by the indigenous? **B (Virreinato 2)**
2. Which of the four *virreinatos* excelled at the exportation of rum? **C = Virreinato 3**
3. Which of the four *virreinatos* was characterized by an indigenous empire that mastered agriculture in the Andean mountains? **A (Virreinato 1)**
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. **Mexico (Nueva España)**.  
*Also seen in countries like Spain and Russia.*
5. List some of the locations explored by La Condamine and his Latin American colleagues, and cite the virreinato or virreinatos they explored together. **Geodetic expedition starting from Quito and explored the virreinato of Peru.**
6. The Expedición Botánica of José Celestino Mutis took place in which virreinato? **Virreinato Nueva Granada (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? **Colegio del Rosario is in Santa Fe de Bogotá in Nueva Granada.**
8. In which country is the Pierre Auger Observatory located? In which virreinato would this country have been in the 18th century? **Argentina in Virreinato 4 (Río de la Plata).**



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

*Well done*

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

*HAWC (High Altitude Water Cherenkov) in which it uses detectors submerged in water. It detects the gamma rays from space that are broken in the atmosphere. It emits blue light when the ray interacts with the detector.*

*-1/2*
- 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?
 

*These cities are located next to Cerro Rico which is where large amounts of silver were discovered. This led to creation of universities which enabled mining in that area and eventually contributed to the enlightenment.*
- 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 located in modern day Bolivia and this area where silver came from for those who controlled it which was the Habsburgs (Austria & Spain). The silver from here became the world's supply. All sorts of goods were in trade for the silver and mules were used to transport the silver to be shipped.*

## 4 Asynchronous Activity Review II

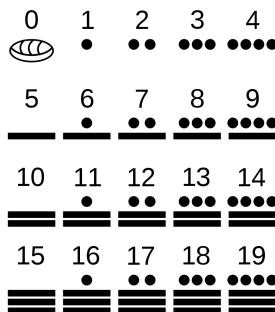


Figure 4: A list of the numerical digits used by the Maya.

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

(a)  $80 + 20 =$

$$\begin{array}{r} 80 + 20 = \\ \textcircled{8} \quad \textcircled{2} \\ \hline \end{array}$$

(b)  $365 + 365 =$

$$\begin{array}{r} \cancel{6}6 + \cancel{6}6 = \\ \hline \end{array}$$

(c)  $1024 + 512 =$  1536

$$\begin{array}{r} \text{---} \\ \text{---} \end{array} + \begin{array}{r} \text{---} \\ \text{---} \end{array} = \begin{array}{r} \text{---} \\ \text{---} \end{array}$$

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

$$(a) \quad 1024 - 512 =$$

$$\begin{array}{r} \text{---} \\ | \\ \cdot \cdot \cdot \\ | \\ \cdot \cdot \\ | \\ \cdot \cdot \end{array} - \begin{array}{r} \text{---} \\ | \\ \cdot \cdot \cdot \\ | \\ \cdot \cdot \\ | \\ \cdot \cdot \end{array} = \begin{array}{r} \text{---} \\ | \\ \cdot \cdot \cdot \\ | \\ \cdot \cdot \\ | \\ \cdot \cdot \end{array}$$

(b)  $92 - 31 =$

$$\begin{array}{r} \text{---} \\ \text{---} \end{array} - \begin{array}{r} \text{---} \\ \text{---} \end{array} = \begin{array}{r} \text{---} \\ \text{---} \end{array}$$

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

(a)  $512 + 256 =$

$$\begin{array}{c} + \\ \text{---} \\ + \end{array} + \begin{array}{c} + \\ \text{---} \\ + \end{array} = \begin{array}{c} + \\ \text{---} \\ + \end{array}$$

(b)  $11 + 89 -$

$$11 + 6j = \begin{array}{c} \text{+} \\ | \\ \bullet \end{array} = \begin{array}{c} \oplus \\ | \\ \bullet \end{array} \xrightarrow{\quad \text{conjugate rule} \quad} \checkmark$$

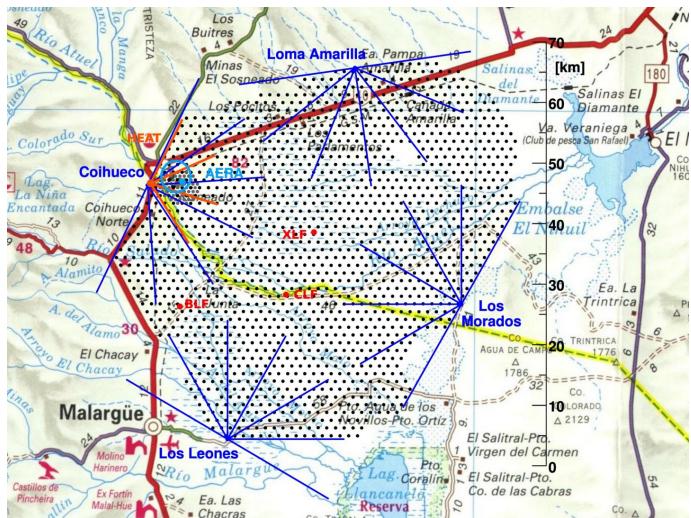


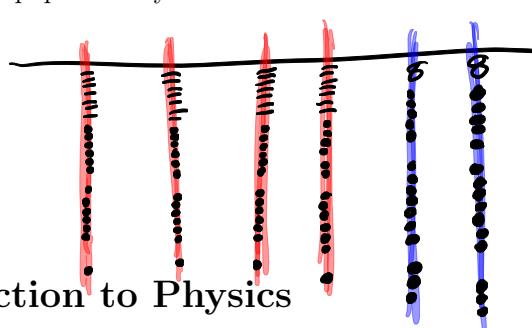
Figure 5: A physics detector near Malargüe, Argentina.

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

$$(a) 365 - 67 =$$
  

$$(b) 1024 - 512 =$$

5. Suppose you have ~~two~~ 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.



$$\text{potato} = \frac{150 \text{ m}}{0.2 \text{ m}} = 3750$$

$$\text{quinoa} = \frac{150 \text{ m}}{0.3 \text{ m}} = 1,667$$

I interpret the quipu to mean  $3750 \times 2$  of  $1667 \times 4$  ✓  
(correct)

## 5 Connection to Physics

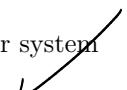
1. In Fig. 5, what physics detector is shown?

- 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.

In Nueva Granada, "modern Science" was slowly adopted by Jesuits who taught Newtonian Physics in late 1780s. Dominican take over made modern science repressed for uniformity & traditionalist but eventually lost influence. (Also dealt w/censorship from the Spanish Crown). In Perú, repression from the Crown led to banned books having to be read from private libraries. The teaching of modern science was inevitable considering how universities are run.

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.

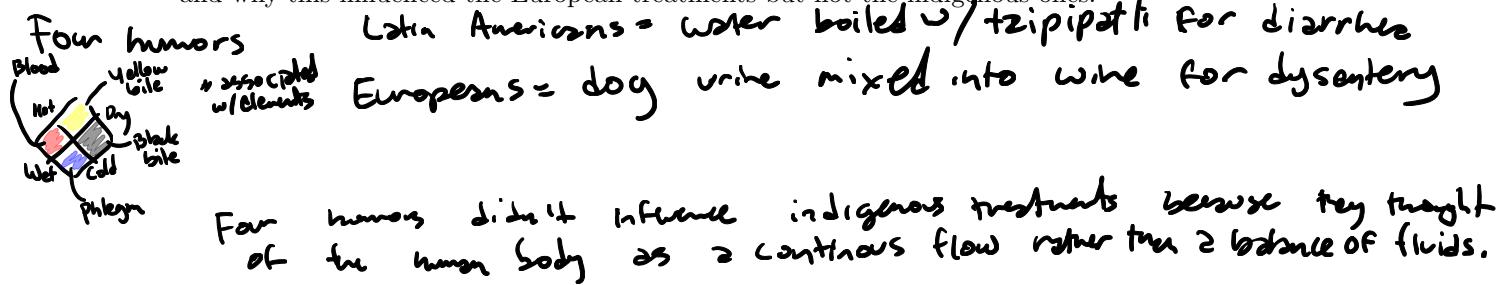
The auror borealis in 1789 was unusual since it was red and in the South unlike those discovered in Spain and Russia.

Léon y Grand = concluded auroras were above atmosphere & that it coincides w/moon phases

Alzate y Ramírez = connected the auror sightings from different areas

Edmond Halley = predicted they were from the poles (which is why it <sup>appears</sup> in Mexico City)

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.



Four humors didn't influence indigenous treatments because they thought of the human body as a continuous flow rather than a balance of fluids.

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) Literature that fueled the French Revolution is censored in Latin America (for obvious reasons).

b) Indigenous remedies/practices/proof of works destroyed by colonization

c) Alzate's works alongside his published works/journal which was very unfavorable to the Church.

d) Missionary priests that recorded some indigenous behaviors and the very few works written in Náhuatl and stored in private libraries.

Well done