Midterm - INTD290

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

February 5, 2021

49/50 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

(a) Virreinato 1 (b) Virreinato 2 (c) Virreinato 3 (d) Virreinato 4

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 huitzilin* classified by the indigenous? Virreinato 2 (Nueva España)
2. Which of the four *virreinatos* excellent at the exportation of rum? Virreinato 3 (Nueva Granada)
3. Which of the four *virreinatos* was characterized by an indigenous empire that mastered agriculture in the Andean mountains? Virreinato 1 (Peru)
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. The aurora was observed in Mexico city in Virreinato 2 also observations in Spain, France, England, Sweden, etc.
5. List some of the locations explored by La Condamine and his Latin American collegues, and cite the virreinato or virreinatos they explored together. La Condamine's expedition to Quito in the Virreinato de Peru had a big impact on the development of science there.
6. The Expedición Botánica of José Celestino Mutis took place in which virreinato? In the Virreinato de Nueva Granada (3)
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? In Santa Fe de Bogotá (Virreinato 3)
8. In which country is the Pierre Auger Observatory located? In which virreinato would this country have been in the 18th century? It is located in Argentina which would have been Virreinato 4 (Río de la Plata)

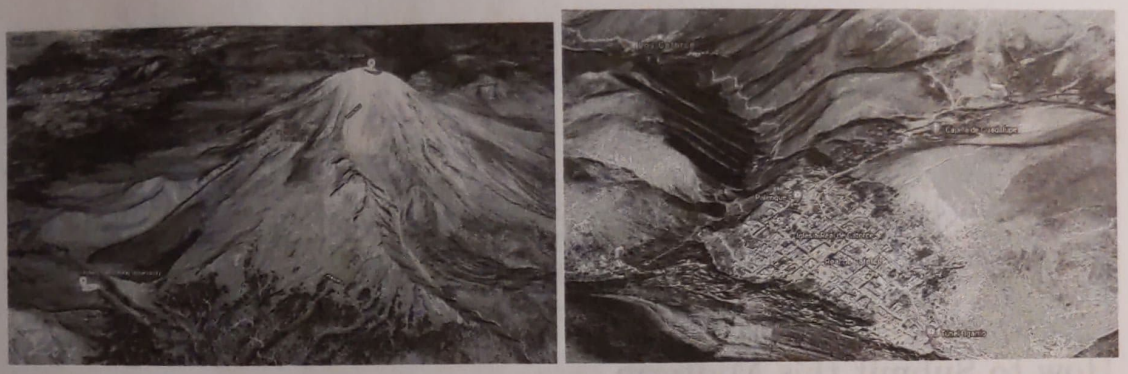


Figure 2: (Left) A physics detector near Pico de Orizaba in Mexico. (Right) A town in central Mexico.

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

3 Asynchronous Activity Review I

1. What is the physics detector shown in Fig. 2 (left)? Explain in basic terms the purpose of this detector and how it works. It is a cosmic ray detector. It works by sensing the angle and energy of the ray based off of the detectable radiation that it gives off when it hits a pool of water (the detector pool shown above). ✓ almost perfect, except it detects mostly gamma rays

→ it can also do cosmic rays

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? Rapid booms in the productivity of mines, and the expansion of cities brought a need for experts and professionals to maintain that economy. "Useful arts" were taught in newly established colleges and it also sparked an interest in science and modern thought. ✓

3. 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? That is Potosí, Bolivia and it is historically significant because of its vast silver mines. It was controlled by the Spanish crown and mining guilds who profitted greatly from the silver. I am not completely sure about the details of silver transport, but the increased trade certainly opened up the economy and trade of the larger Latin America. ✓

4 Asynchronous Activity Review II

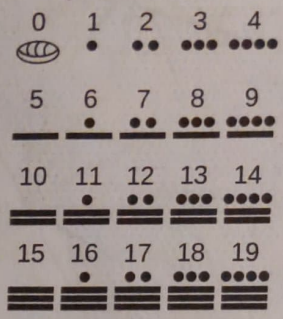
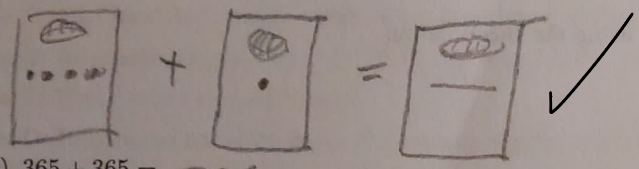


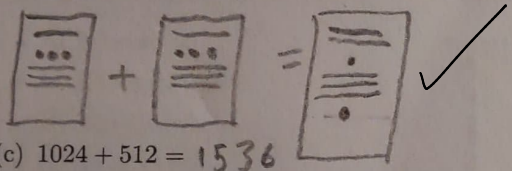
Figure 4: A list of the numerical digits used by the Maya.

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

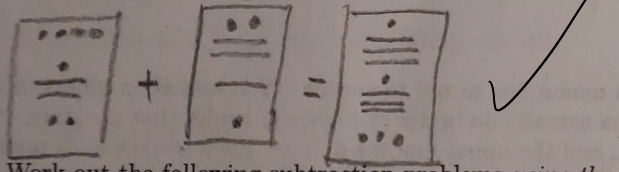
   (a) $80 + 20 =$ 100

   (b) $365 + 365 =$ 730

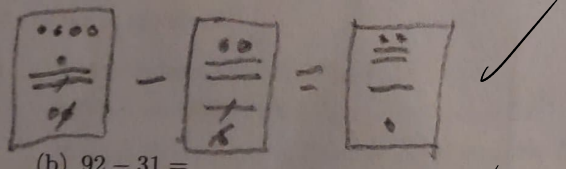
   

   (c) $1024 + 512 =$ 1536

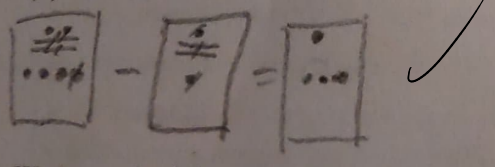
   

2. Work out the following subtraction problems *using the Mayan system.*

   (a) $1024 - 512 =$

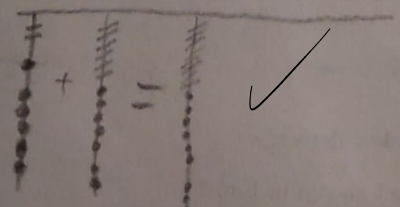
   

   (b) $92 - 31 =$

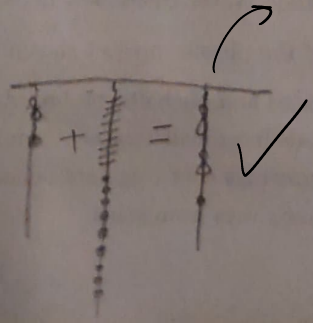
   

3. Work out the following addition problems *using the Incan quipu:*

   (a) $512 + 256 =$ 768

   (b) $11 + 89 =$ 100

although in the ancient system it's rare to see $\$$ rarely it's just a space

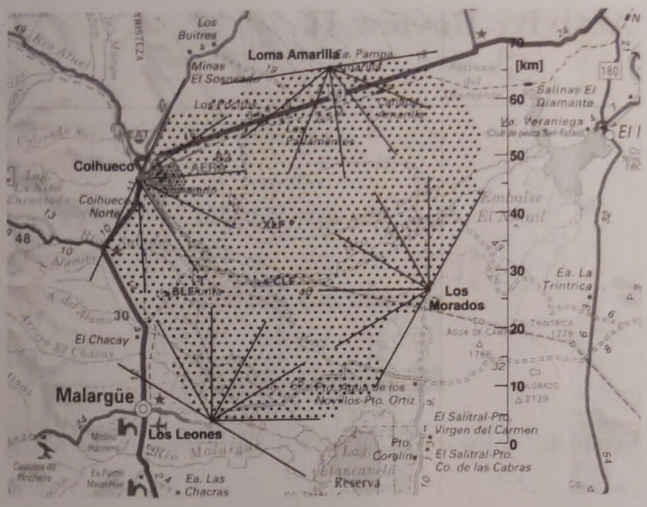
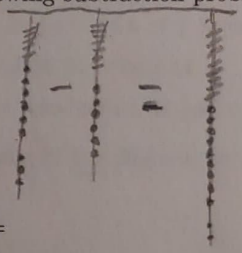


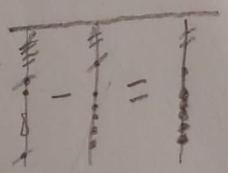
Figure 5: A physics detector near Malargüe, Argentina.

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

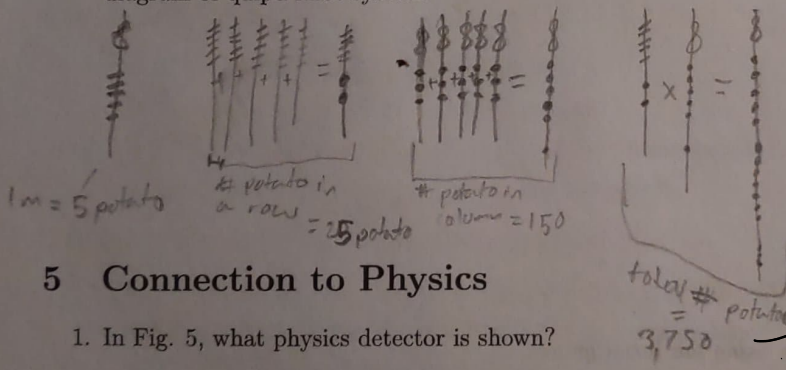
   (a) $365 - 67 =$

   (b) $1024 - 512 =$

5. Suppose you have six 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 that 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.



almost, because there are 2 terraces, 3750 × 2 = 7500

(667 quinoa)

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 *ahuizotl?*
   - 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 guids 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.

The battle to bring Enlightenment ideals to Nueva Granada and Peru was often hard fought as strong religious restrictions were placed on the universities. Professors from within universities tried to bring modern science into the curriculum and they were able to maintain that curriculum until Inquisition and scholasticism returned religion to the education. This was largely because of the control seized by the Dominican order (pushed for scholasticism) after the Jesuits were expelled.

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 low-latitude aurora observed by José Antonio Alzate and Antonio de Leon y Gama was significant because no aurora has ever been recorded so low and it sparked scientific inquiry across the globe. Alzate y Ramirez looked at this phenomenon as a pattern and noted that it would be observable in other countries. This discovery put Latin America on the map, so to speak, of world science. Others who joined the research were →

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. Pre-Enlightenment medicine revolved around the notion that all disease could be explained by imbalance in one or more of four bodily liquids. European scientists that came to America sought out herbs that they could incorporate into their four humors model without realizing that indigenous treatments (based on generations of herbal medicine) were much more effective. Using tzipatli with atole, the natives were able to ease gastrointestinal illness much more effectively than Europeans.

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) In the Viceroyalty of Peru, the illegal importation of French and Spanish Enlightenment texts caused the intervention of catholic inquisitors and bans on certain authors. b) In Mexico, José Antonio Alzate y Ramirez began several scientific journals that even reached Europe, but not without attempts to shut down and censor him. c) Alzate was a catholic priest who contributed to Latin American knowledge, but other clergy members such as Father Cisneros also propagated that knowledge through bookstores. d) Father Bernardino de Sahagún

2. cont'd: Sir Edmund Halley in Britain, Ben Franklin in the colonies, and Jean-Jacques D'ortous de Mairan in France

4. cont'd: was able to keep some record of Mexican medicine and Nahuatl culture in the 16th Century. Father Diego Durán also recorded native descriptions of the huitzilin and the spiritual connection that it held to Huitzilopochtli.