**OIL: EXAM 1**

**Part 1: From Plankton to your Car (and iPhone)**

1. What is energy? Why is oil a good source of energy?
   1. Energy: property of objects which can be transferred to other objects or converted into different forms, but cannot be created or destroyed—capacity or power to do work
   2. Oil is one of the most plentiful energy resources, liquid form of oil makes it easy to transport and use, oil has high heating value, relatively inexpensive, no new technology needed to use
2. Define Light crude vs. Heavy crude (Texas)
   1. Light (North Texas): liquid petroleum with low density and flows freely at room temperature. Higher price than heavy because it produces a higher % of gasoline and diesel fuel when converted into products by an oil refinery.
   2. Heavy (Southwest Texas): “pours like molasses”. Very viscous (sticky), cannot easily flow to production wells under normal reservoir conditions, more severe environmental impact
3. What is meant by the statement—Oil is stored sunlight?
   1. Microscopic one-celled plants
   2. Oil compounds are released in the bottom of the ocean and warmed by the geothermal energy of the earth
   3. Subjected to pressure from the overlying sediment
   4. Energy in petroleum is originally from solar energy—turned into chemical energy by the plants (photosynthesis), and stored in the remains of the ancient plants and animals
4. What does the term “maturation” mean? What is meant by the term “oil window?
   1. Maturation: process of complex organics🡪chain hydrocarbons
      1. Temperature (burial depth) + time
      2. Temperature puts a limit on where oil can exist
   2. Oil window: depth of which the processes of turning kerogen into oil can occur—from 6,000-7,000 feet to 13,000-15,000 feet.
      1. Source rock will be “cracked” into oil
      2. At greater depths, you would reach gas and not oil
5. Define Reservoir rock (include the differences between porosity and permeability)
   1. Reservoir rock: rock that has porous coarse-grained sands sufficient enough to contain collections of water, oil, or gas
      1. Sand and clayey beds from collision
   2. Porosity: measure of a rock’s ability to hold a fluid—tiny spaces in the rock that can hold the oil or gas
   3. Permeability: measure of the resistance to the flow of a fluid through a rock—characteristic that allows the oil and gas to flow through the rock
      1. If it takes a lot of pressure to squeeze fluid through a rock=low permeability
6. **SKETCH of oil trap**
7. Explain how oil drilling/extraction works for a standard Surface-well—from the drilling method through getting oil to the surface (if there is not gas pressure). HINT: you also don’t want your hole to collapse [3 points extra credit if you avoid blow outs while drilling)
   1. Drilling
      1. Using rotary cone bits, make sure to lubricate it
      2. Remove the cuttings
      3. Hold back pore fluids (and oil-gas)
   2. Extracting
      1. Surface casing—to keep hole from collapsing
      2. Cementing—isolating the producing interval to maintain an internal “clean” pipe
      3. Puncturing the casing to stimulate the well—pressure to open fractures
      4. From the reservoir pressure, there is sometimes a natural flow of oil, which is considered to be a gusher. There is also an option to pump the oil, which is lifting the oil NOT suctioning it.
      5. The secondary recovery involves pumping water into the wells to extract the oil. Saudi Arabia uses this tactic with sea water.
8. What are some environmental concerns with Fracking? With extraction of oil for Tar Sands?
   1. Fracking: process of drilling and injecting fluid into the ground at a high pressure in order to fracture shale rocks to release natural gas inside
      1. Dangers:
      2. Takes 1-8 million gallons of water to complete each fracturing job
      3. Approximately 40,000 gallons of chemicals are used per fracturing—up to 600 chemicals used
      4. Methane gas and toxic chemicals leach out and infect nearby groundwater—pollutes drinking water
         1. Sensory, respiratory, and neurological damage people
   2. Tar sands require large facilities that take up large areas/cities, with smoke stacks spewing pollutants in the air and wastewater from the process are emptied are stored in huge toxic tailings ponds that can be seen from space—they leak 11 million liters of toxic waste per day and seep into groundwater
9. What is a basin and under which geological (tectonic) situations will they form?—geologic location
   1. Basin: regions of the earth of long-term sinking creating accommodation space for infilling sediments—results from the thinning of underlying crust, sedimentary, volcanic, and tectonic loading, and changes in the thickness or density of the adjacent atmosphere
   2. Occur in diverse geological settings usually associated with plate tectonic activity—formed in various plate tectonic regime (divergent, convergent, transform, intraplate) and whether oceanic, continental, or transitional crust underlines the basin
10. What is a salt dome?
    1. Salt dome: dome-shaped structure formed where a large mass of salt has been forced upward-
       1. Often form traps for oil or natural gas
11. Why are fewer exploratory wells being drilled today, but same time we are having a greater success in finding new oil?
    1. It is becoming more expensive to fund the explorations
12. **SKETCH of refining column**
13. What is meant by the “cracking” refining in process?
    1. Cracking: breaking a long-chain of hydrocarbons into short ones—any type of splitting of molecules under the influence of heat, catalysts, and solvents,
    2. oil and gases are treated with cracking in order to make them useful
    3. most value are liquefied petroleum gas, naptha, kerosene and gas oil
14. How does Internal Combustion engine work?
    1. An engine that generates motive power by the burning of gasoline, oil or other fuel with air inside the engine, the hot gases produced being used to drive a piston or do other work as they expand
    2. Seen mostly with transportation
15. The major use of oil is for transportation, why is it difficult to switch to an alternative source of energy for transportation?
    1. Political issues—many people are deeply invested in this industry, the expenses of switching sources, and no pressing need to switch
    2. Advantages: high energy density—small amount can produce a large amount of energy, easy availability, crucial for wide variety of industry, easy to produce and refine, and constant power source and reliability
16. What is propane, and how is it used in modern society?
    1. Propane: non-toxic, colorless and odorless gas that can be turned into a liquid to make transportation easier. Made from petroleum products including crude oil refining and natural gas processing
    2. Propane is used for heating pools, patio heaters, gas cooktops in the kitchen, clothes dryers, fireplaces—HEAT
17. What is propylene and how is it used in modern society?
    1. Propylene: gas—2nd most produced organic compound
    2. Used to make plastic products, food packaging, and thermal clothing
18. What feature of xylene had to be solved before it could be used to make those pervasive water bottles?
    1. Paraxylene—least common + most desired product
    2. Metaxylene—most common + least desired
    3. All three xylenes (ortho-, meta-, and para-) are difficult to separate due to similar molecular structure
19. How do you make Synfuel?
    1. Synthetic fuels—any fuel produced by “coal, natural gas or biomass feedstocks through chemical conversion”
       1. Ex) Fischer Tropsch conversion—coal🡪gasoline

**PART 2: Oil—the first Century**

1. Why was there much interest in finding an abundant source of kerosene during the middle part of the 19th century?
   1. Oil began with whales—extracted oil from fat and heated it up for light
   2. Whales were on the brink of extinction and became expensive
   3. Initiated the search for an alternative—1857 Colonel Drake’s well in PA
   4. Rock oil (petroleum) burns bright and is cheaper
   5. Whales were saved!
2. Pick one of the following people. Explain their role in oil history, and an aspect of his/her personality:
   1. **Marcus Samuels**
      1. The initial beginning of Shell
      2. Name came from their initial family trading company with Far East
      3. Joined forces with Rothschild against Rockefeller and challenged Standard Oil
   2. **Carl Ickes--Harold**
      1. Advisor to Roosevelt
      2. Secretary of the Interior
      3. In charge of national oil policy during WWII
         1. Adequate petroleum reserve for national security
   3. **“Boy” Hunt**
      1. Bought out Joiner (70 year old promoter chasing widows to drill in their yards) with a loan from men’s clothing store
      2. Discovered East Texas Field 1930—one of the largest fields discovered
   4. **John D. Rockefeller**
      1. Standard Oil
      2. Decided to put an organization with oil production—monopolized to gain control of the competition
      3. Undersold competitors by receiving special rates from railroads which made shipping his oil cheaper
         1. Hidden payments/drawbacks
      4. Had 90% market ownership at one point
      5. Saving a penny wherever he could, obsessed with secrecy, divided life into compartments
      6. Lost his entire empire from an exposure article written by Ida Tarbell
   5. **Ibn Saud**
      1. Created “Saudi” Arabia—gave name to the regions in Arabia he had unified
      2. Petroleum was discovered in 1938
      3. Granted substantial authority of Saudi oil fields to American Companies in 1944
   6. **Armand Hammer**
      1. Invested in several U.S. oil production efforts
      2. CEO of Occidental Petroleum—one of the largest oil producers in Texas
         1. Houston-based oil and gas exploration and production company
      3. Considered as the “Pioneer in the synfuels boom”
3. Pick one of the following companies—for origin of this company, explain which geological situation caused the concentration of hydrocarbons that were originally exploited and led to its initial success
   1. Shell
      1. Caspian Sea = 2 oil basins
      2. Buried source = upwelling margin🡪led to nutrients at the surface
      3. Miocene collision—Iran collides with Russia/Asia🡪new mountains and lake deepening (later becomes the Caspian Sea)
      4. South Caspian is 900 m deep. Below it is 20 km of sediment, which oil maturity occurs at 10 km and filters up. There was enough heat/pressure/time to create oil.
4. What did John D. Rockefeller in the United States and Marcus Samuels in Baku do to bring order to the industry during the latter part of the 19th century?
   1. **Rockefeller in the US**
      1. Monopolized Standard Oil to gain control of the competition
      2. Standard Oil became the first “vertically integrated” company—combined 4 businesses of: production, refinery, selling and marketing
      3. Controlled refineries, built a pipeline and made a trust to control most of the industry
   2. **Samuels in Baku (present day Russia)**
      1. Became interested in the oil exporting business based in Baku
      2. Utilized tankers to ship oil from Baku to Far East
      3. Adopted Standard Oil’s tactic of cans for holding kerosene and produced his own red ones
      4. Joined forces with the Royal Dutch Petroleum to challenge Rockefeller
5. The BTC pipeline was built to avoid Russia; but much of its contorted route is to avoid other “hot spots”. Briefly explain two of these hot-spots. \*\* draw diagram
   1. Pipeline bypasses through Armenia which has conflict with Azerbajain (Baku is the capital of Az)
   2. Georgia separatist (protestor) conflicts
   3. Separatists in Kurdish regions of Turkey
6. Explain how the Flapper age of the 1920s led to predictions of a crisis in American oil availability.
   1. 1920’s car craze—a man with a car has a means for escape to entertainment, drinking, and distant privacy
   2. Buying cars became more common using a line of credit and charging interest
   3. 1927: 1 car per every 5 people
   4. Recognized that the oil supply was being depleted
   5. Oil prices began to climb—more than double
   6. More highways = more driving = more fuel needed
7. What was the “Red Line Agreement” that led to the “Seven Sisters”?
   1. A deal struck between American, French, and British oil companies concerning oil in the Middle East with the Turkish Petroleum Company
   2. Marked the creation of an oil cartel, spanning over a vast territory
   3. 7 sisters: Standard Oil NJ (Exxon), Standard Oil NY (Mobil), Standard Oil California (Chevron), Texas Oil Co (Texaco), Gulf Oil, Anglo Persian (BP), Royal Dutch (Shell)—Every Morning Cheese Tastes Good Because Stringy
   4. Agreement allowed them to operate in Middle East with 5% of profits going to Gulbenkian. There was also a self-denying clause that companies needed support from others to develop oil fields in Middle East.
8. The price of oil in USA plummeted at the end of the 1920’s, nearly driving major oil companies bankrupt. (a) What was the main reason for this severe price drop, and (b) How did major oil companies and US government force prices to rise again?
   1. A huge amount of oil was found in Kilgore, TX
      1. This led to a giant surplus, which drove down demand and prices
   2. The National Guard was called in to stop production. Too much money was invested by the “big dawgs” to lose more $ at 2 cents/barrel. This led to regulating production with quotas and policies.
9. Briefly describe the “oil strategy” of Hitler’s military machine during WWII, and what went wrong.
   1. Blitzkrieg was the strategy to end the war quickly with strategic bombing. Germans unknowingly had fewer raw materials than the Soviet Union and did not consider the size of Russia. By the time Hitler participated in the air battle for Britain, they already had oil and wanted to take on Britain but the US had better refining.
10. Why did Hitler consider taking Stalingrad to be more important than taking Moscow?
    1. Stalingrad was a major resource hub and industrial center. It had access to Russian oil, and taking it could cease transport of resources to the north.
11. Briefly describe the “oil strategy” of Japan’s military machine during WWII, and what went wrong.
    1. Japan had no oil so they use SE Asia and the Pacific Rim to get sources (part of empirical imperialism)
    2. When Japan invaded the Dutch East Indies, US placed an embargo on Japan, cutting their oil supply
    3. This led to Pearl Harbor (did not destroy USA’s oil tanks though)
    4. USA submarines cut off Japan’s resources even more
    5. Kamikaze attacks did not last long since Japan ran out of oil to fuel the suicidal missions
12. Give two examples of how Texas oil weath have influenced USA’s national politics:
    1. Lyndon Jonhson was a product of Texas fortune. Texans backed Lyndon Johnson and he accepted Kennedy’s VP spot, but Kennedy was killed which left Johnson to replace Kennedy
    2. Koch brothers and their Tea Party support—very conservative political group who are not in favor of Obama’s decisions
    3. Bush dynasty as a result of George Bush Sr. offshore drilling
13. What was the major episode that involved the CIA and British Secret Service in Iran politics in the 1950s?
    1. 1953 Iranian Coup—Operation AJAX
    2. British were kicked out of Iran because they wouldn’t give Iran half of their profit
    3. Britain put an embargo on Iranian oil, which was a major source of government revenue—strategically made Iranians poorer and unhappier by the day
    4. The CIA supported the opposition in Iran and overthrow Iran’s Prime Minister, Mosaddegh, through mob organization in support of the Shah who was restored to power